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(INCORPORATED).

VOL. L.

[WITH FIFTY-THREE PLATES, AND THIRTY-NINE FIGURES IN THE TEXT.]

EDITED BY PROFESSOR WALTER HOWCHIN, F.G.S.,
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Transactions

of

The Royal Society of South Australia (Incorporated)

VOL. L.

THE GEOLOGY OF THE BAROSSA RANGES AND NEIGHBOURHOOD IN RELATION TO THE GEOLOGICAL AXIS OF THE COUNTRY.

By PROFESSOR WALTER HOWCHIN, F.G.S.

[Read November 12, 1925.]

PLATE I.

CONTENTS.

I. INTRODUCTION.

The most important geological horizon in the structure of the Mount Lofty and associated ranges is a highly complex series of rocks of Pre-Cambrian age. These rocks in their lithological types and stratigraphical structures are so different from all other associated rocks that they cannot well be confused with newer formations. They are the oldest rocks known in Australia and they form the geological axis on and around which the newer geological systems have been laid in succession.

One of the oldest tectonic folds in the structure of South Australia gave these fundamental rocks an axial elevation, and subsequent denudation has brought them near the surface or exposed them at the surface in many places. This sunken ridge of oldest rocks can be followed at intervals, in a north-easterly direction, from Yankalilla, following the eastern side of the Inman Valley, by Mount Compass, Aldgate, the River Torrens near Castambul, Houghton, Millbrook, Gumeracha, Mount Gawler, Humbug Scrub, and the South Para near Williamstown;

outcrops of these rocks sometimes showing a width of several miles. Here we possess a geological datum of first importance, and the whole geological structure of the country must be viewed with respect to this definite horizon.

The geological succession as it occurs on the western side of this axis near Adelaide is perfectly clear [(13) p. 341, fig. 262]. Newer beds that are strongly unconformable to the basement series follow in regular order with a general dip towards the south-west, the newer members of the series form the cliffs and sea platforms on the shores of Gulf St. Vincent at Marino and further south, and extend westward to Yorke Peninsula.

The order of succession of the rocks on the eastern side of the main geological axis is not so clear as it is on the western side. This arises partly from the contrast in the topographical features in the two areas. On the western side of the axis there is a rapid descent from the maximum height to sea level, which is reached in a direct line in 12 miles. The country on the eastern side, on the other hand, forms a dissected peneplain in which the outcrops of the respective beds take in a wider spread and, in the hilly country, are not so easily followed.

A still greater difficulty confronts the geological observer in the country to the eastward of Mount Lofty on account of the regional metamorphism that the rocks have undergone in that direction, which has transformed most of the sediments to a degree that places them beyond recognition as to their original form. This metamorphism increases in intensity the further we go eastward, until the whole sedimentary series becomes interpenetrated and transformed by a great igneous belt. It has followed, that this part of the country has been considered the most difficult of determination of all the geological fields in South Australia.

The late Professor Tate failed to recognise the presence of a divisional axis in the Mount Lofty Ranges, or the change of dip on the western side as compared with the eastern. In his Inaugural Address at the Adelaide Meeting of the Australasian Association for the Advancement of Science, in 1893, he says: "The grandest exemplification of the Archaeans is in the Mount Lofty Ranges of South Australia. These rocks occupy there a vast monocline, with a dip to the south-east, of not less than 10 miles in thickness." Tate was correct in his statement of a general dip to the south-east of the beds on the eastern side of Mount Lofty, but that any series of beds could be 10 miles in thickness is an impossibility. In reality we have to deduct from his 10 miles of thickness all the beds that occur on the western side of Mount Lofty, which reduces his figures by one-half, and at the same time some allowance must be made for the rolling of the beds which reduces their true thickness still further.

Dr. Woolnough fell into the same error in his "Notes on the Geology of the Mount Lofty Ranges" (9). In his section fig. 1 (p. 126) he takes no account of the great dividing line, between west and east, made by the older rocks which form an inlier two miles in width on the eastern side of Mount Lofty. The mount, in his section, forms a part of the eastern series with a corresponding dip with that series; whilst, in fact, the beds dip westerly in accordance with the western limb of the section.

In 1907, the writer (7) summarized the evidences in favour of the view that the beds on the eastern side of the Mount Lofty Ranges are a repetition of those on the western side. The chief points thus stated, briefly put, are:—

1. The general dip on either side of the Pre-Cambrian axis of elevation is complemental in its direction—on the Adelaide side to the west, and on the other side to the east.

2. The basal conglomerates and ilmenite grits of the Inman Valley and other places have a dip to the south-east, and exhibit in superposition a series of

quartzites and slates which become more schistose in their upper members as they approach the great granitic zone of the coasts.

3. In other instances known horizons of the Proterozoic (or [?] Cambrian) rocks can be traced from their unaltered condition into the region of contact where they are powerfully affected and altered, as east of Kapunda, Olary, Umberatana, etc.

4. The most distinctive horizons of the lower beds of the Proterozoic (or [?] Cambrian) on the western side can be correlated with those on the eastern, up to a certain horizon.

5. The highly altered character of the beds on the eastern side can be explained by the great extent of the igneous zone and associated regional metamorphism as a consequent of their former deep-seated condition.

It is proposed in the present paper to offer confirmatory evidences on this point in a section taken through the Barossa Ranges and adjacent country. The line of section is in a direction E.N.E. and W.S.W., a little to the southward of the township of Williamstown.

Dr. Woolnough, in his paper referred to above (9), suggests the name "Barossian" for the beds on the eastern side of Mount Lofty, which he assumed to be an older series than those on the western side of that mount, which is known as the "Adelaide Series." But the name "Barossian" is entirely inappropriate, inasmuch as the beds he thus named are a repetition of the Adelaide Series as they occur on the eastern side of the axis. The name is equally inappropriate if applied to the Barossa Ranges, as these ranges also consist of the Adelaide Series. The Archaean, or Fundamental Rocks, are most extensively developed in the Talunga and Para Wirra Hundreds, and are only seen in the Hundred of Barossa in a narrow strip, a few chains in width, on the northern bank of the South Para. To avoid misunderstanding and confusion, it is desirable to adopt some other term than that suggested by Dr. Woolnough for the Fundamental Series of South Australia.

Dr. W. N. Benson has described (10) in some detail the stratigraphical and petrographical features of these oldest rocks of South Australia as they occur in the Houghton District, situated about 12 miles north-eastward of Adelaide. He described from this neighbourhood a new variety of pegmatite, which he named *yatalite*, and also recognised certain distinctive features in the intrusive rocks of this and other districts which led him to name the particular type, the "Houghton magma." As the locality is easily accessible and quite typical of the Fundamental Rocks of the State, I would suggest the name *Houghtonian* as a convenient and appropriate name for the Series.

II. THE HOUGHTONIAN OR FUNDAMENTAL COMPLEX.

The gold rushes that took place about 40 years ago in the Hundreds of Para Wirra and Barossa led to some detailed geological mapping of the country in which the gold-fields were situated (2), (3), (4), (8). The principal centres were known, respectively, as the Gumeracha, the Humbug Scrub, and the Barossa Diggings. The gold was obtained mostly from alluvial ground, but a number of shafts were sunk in the bed rock.

Messrs. Brown and Woodward, in their "Geological Map of Gumeracha and Mount Crawford Goldfields" (3), describe the two older series in the districts named as:—

"Lower Silurian ? (Bed rock), micaceous, chloritic, and clay slates, sandstones, and quartzites."

"Highly Metamorphic (Bed rock), mica schist, and gneissic rock with granite dykes."

The upper of these systems can be classed as the Adelaide Series, which may be either of Proterozoic or Lower Cambrian age; and the lower, as Archaean or Fundamental Complex (Houghtonian).

The rocks belonging to the Fundamental Series cover a considerable area in the district under consideration. They follow the gorge of the South Para, starting from a point, about one mile and a half below Mount Crawford, they continue in outcrop on both sides of the river for about $7\frac{1}{2}$ miles, by direct measurement (11 miles as the river runs), and come to an end, in a westerly direction, a little below a prominence in the south bank, locally known as the "devil's nose," forming part of Section 3280, Hundred of Para Wirra. At the southern extremity of the Barossa Waterworks Reserve (Sec. 177) there are quarries close to the river in massive augen gneiss, the stone from which was used in building the weir for the Barossa Reservoir.

On the northern side of the river (Hd. of Barossa) the Fundamental Rocks have an average width to the river of about half a mile, much of which is obscured by a covering of the older alluvium.

On the southern side of the South Para (Hd. of Para Wirra) they cover a large area. They go southwards, by Horse Gully, and cross into the Hundred of Talunga, extending southwards by Forreston and Gumeracha.

To the westward (Hd. of Para Wirra), they take in the Humbug Scrub (so named from its inhospitable character) and run out before reaching the Tenafeate Creek, which forms the boundary between the Hundreds of Para Wirra and Munno Para, but are continued southwards by Mount Gawler, Millbrook, and Houghton to the River Torrens.

The lithological features of these oldest of South Australian rocks are extremely varied. The felspar constituent is usually very abundant in the form of Aplites, Syenites, and Pegmatite. Rocks of a sedimentary origin are represented by schists and quartzites. The schistose varieties are frequently penetrated along the laminae by pegmatitic intrusions or segregations. Augen gneiss covers large areas. Quartz veins often carry primary ilmenite and other accessory minerals. Silicates and oxides are very common, among which beryl and rutile are characteristic. In the neighbourhood of the Para, from the bridge (now submerged) at the (former) Recreation Reserve and for one and a half miles down the stream, as well as in country south of the river, there is a remarkable development of foliated and contorted schists with reefs and blows of pegmatite. The late Captain Warren developed several rutile mines in the neighbourhood; those in Section 17 (Hd. Para Wirra) were in kaolin, carrying a variety of serpentine and also magnesite; while those in Section 674 were chiefly in talc. [For more detailed lithological descriptions see Bibliographical References (6), (10), (11), (14).]

III. THE ADELAIDE SERIES (PROTEROZOIC OR LOWER CAMBRIAN).

1. The Eastern Section (pl. i., fig., 1).

The type district for this series lies between Aldgate and the shores of Gulf St. Vincent. The series consists of conglomerates, quartzites, slates, shales, tillite, and limestones. On the western side of the axis the lower beds are more altered than those in the upper parts of the series; while, on the eastern side, the metamorphism becomes more marked in the upper members as they pass under the influence of the regional metamorphism and igneous intrusions which operated on that side. The Barossa geological succession shows a general likeness to that of the beds which form the western limb of the fold up to a certain horizon—the Upper Phyllites and Slates—which follow in an ascending order on the

Glen Osmond and Mitcham quartzite, beyond which observations have not been carried. The main divisions in the series are considered below.

(1) The Basal Conglomerate and Grits.

These occur in the Barossa district, as elsewhere, resting unconformably on the Houghtonian Series in a marginal zone around the latter. Near the base the rock is usually conglomeratic with the pebbles somewhat irregularly distributed through the matrix, which is often more or less micaceous, very highly charged with clastic ilmenite. The included stones are mostly worn to a nearly spherical form, and are sometimes flattened under pressure into lenticles. The pebbles consist almost entirely of one class of rock, quartz or a very siliceous quartzite. The sameness of composition and irregular distribution of the pebbles through the matrix may have arisen from the metamorphic action by which the less siliceous stones became simultaneously changed with the argillaceous portions of the matrix and absorbed into the latter.

This horizon is strongly marked by current bedding, the lines being brought out with greater distinctness by the black layers of ilmenite grains. The upper portions of the basal beds consist of grits and sandstones, and as they have been derived from the breaking up of pegmatites and quartz veins, the rock partakes of an arkose character which, when coarse, is not always easily distinguished from the granitic rocks from which it has been derived. The finer grained sandstones of the upper layers are usually light coloured, closely resembling the Aldgate "freestone," and usually show fine threads of ilmenite on the planes of the current bedding.

The greatest exposures of the basal conglomerate that I know anywhere occur near Williamstown. On the western side of the main road to Birdwood (Blumberg) these beds rise in a series of scrubby ranges, fully three-quarters of a mile wide. They are very rich in clastic ilmenite, which is sometimes present up to 50 per cent. of the mass, and gives the rock a black colour. They can be traced to the margin of the older rocks which, in foliated and gneissic schists, overlook the gorge of the South Para at about a quarter of a mile distance.

On the eastern side of the Birdwood road the basal beds have the character of light-coloured grits. In Section 120, there is a Stone Reserve in these beds by the side of the road showing typical features [dip E. 10° N. at 40°]. In one of these small quarries there is a pegmatite vein 2 feet in width with selvages of felspar, about 1 inch in width, whilst the greater part of the vein consists of coarse aggregates of mica, quartz, and felspar with primary ilmenite. A smaller vein, 4 inches wide, is seen to strike off from the main vein, and is again split into two, each branch being 2 inches in width.

Further down the road, and shortly before coming to the bridge [since these observations were made (1913) this part of the road has been submerged in the Warren Reservoir and a new road opened further to the east] that crosses the South Para, a gate on the western side of the road leads into a (? woodman's) track that goes up to the summit of a ridge in which the proximity of the basal beds to the lower unconformable series can be studied. About 100 yards in from the gate on the Birdwood road a vein of greison is seen penetrating the basal grits. The greison is very coarse and greatly contorted in the grain, and weathers with the mica exposed in prominent edges. At the bridge, just mentioned, the older rocks occur on both sides of the stream.

To the eastward of the Birdwood road the quartzite, in Sections 3101, 942, etc., is penetrated with pegmatite in larger or smaller veins. One such pegmatite intrusion in these beds is 60 yards wide and seems to have a considerable

extension, as it is seen on the Victoria Creek road, one and a half miles to the northward, and passes southwards to the South Para River, covering a distance of about two and a half miles in all. It is uncertain how far the basal sandstones (or quartzites) go in this direction. At Mr. Mauser's farmstead, situated to the eastward of Springfield (Sec. 951), there is a white sandstone, with dip E. 20° N., and in the bed of the South Para, three-quarters of a mile to the westward of Mount Crawford, there is a white siliceous sandstone containing specks of a green-coloured silicate [dip N.E. at 38°]. At the bridge over the river, on the western side of the mount (Sec. 639), there is a light-coloured, variegated, sandy to argillaceous rock with numerous concentric and contorted lines in it, similar to stones of a like kind in the Mount Lofty and Aldgate beds.

On the northern side of the Archaean inlier, at Williamstown Recreation Ground (now resumed by the Government), the ilmenite sandstones are seen in the Victoria Creek, where there is a distinct anticline in these beds with a strike N. 10° W. The same beds occur on the range at the back of the old Recreation Ground. Up the Victoria Creek there are more folds with a dip N.E.

(2) The Lower Schists.

Next in succession superior to the basal grits is a series of beds that are in the main of a schistose character. The most characteristic mineral is biotite, with other varieties, as spotted schist, knotted schist, tremolite schist, actinolite schist, and amphibolite schist. These can be studied in their outcrops between Lyndoch and Williamstown, the track being mostly on the line of strike; also from near Williamstown, in an easterly direction, where the route is at right angles to the strike. In places, the scales of mica have imbibed moisture and have run together, forming a hydro-mica; in other cases the micaceous structure passes by gradation into a translucent greenish variety of serpentine. Interstratified with the mica schists are beds of limestone and thin quartzites. It seems perfectly clear that these schists which overlie the ilmenitic grits represent the lower phyllites, chloritic, and sericitic schists, which occupy a similar stratigraphical position to the basal grits in the Adelaide Series on the western side of the primary geological axis. The lithological difference is only in the degree of metamorphic action that the respective beds have been subjected to.

In these Lower Schists is a zone of pegmatization which outcrops a little lower in the series than the limestone which begins near Mr. Hammond's house (Sec. 1521) and continues on the same geological horizon up the gully to its head and over a ridge down to the Birdwood (Blumberg) road, a distance of two miles. The pegmatite occurs as lenticles in mica schist varying in width up to 30 feet by 12 feet. Near the head of Hamilton Gully, on the eastern side, the mica schist carries a good deal of the green variety of serpentine (pinite, from hydro-mica) in layers, varying in thickness from a thin film up to several inches.

The flaggy quartzite that forms a scarp ridge above the limestone (mentioned above), and has been quarried for long distances, shows a dip of 55° easterly.

(3) The Lower Limestones.

Two miles north of Williamstown there is an outcrop of a white schistose marble containing lath-shaped crystals. The marble occurs in Section 511, in a small creek, near an old copper "prospect," about a quarter of a mile from the main Lyndoch road and on the north side of the cross roads, going east, which forms the southern boundary of the Section named. The strike is N. 20° W., dip E. 20° N. at 30°. The rock is intensely folded, several acute folds occurring within a few yards. The rock is divided up into numerous small beds, separated

by earthy beds or partings. A little further to the east, in the same paddock, there is much surface travertine, but no parent rock was visible, although it is probable that the limestone is below the surface.

At a well in the adjoining farm yard, the sandstone thrown out in sinking the well contained dark lines suggestive of the stone being an ilmenite, or basal, sandstone. The strike of the beds at this point would harmonise with that of the basal grits two miles to the southward, near Williamstown.

Limestones on the same line of strike occur on the eastern side of the north-eastern road, one and a half miles from Williamstown. At Mr. John S. Hammit's there are two kinds of limestone (marble) outcrops, one close to the house, in Section 3053. At a short distance, north, from the house, on the hillside, is the old (copper) Enterprise Mine. At the surface, near the shaft, the country consists of laminated slates, somewhat micaceous, with a strike N. 20° W., dip E. 20° N. at 65°. I was informed by Mr. J. S. Hammit that marble was met with in the shaft at a depth of 120 feet and was penetrated 90 feet without reaching the bottom of the bed. The lode was running north and south and was capped by a strong quartz reef. Mr. Hammit also stated that the marble was found in sinking a gate posthole at his apple shed, and is also seen in the adjacent orchard, and can be traced up to the top of the hills on the southern side, showing a strike S. 20° E. This line of strike was not followed, but the outcrop of the limestone could be seen for about a mile ahead.

The other limestone, also a marble, near Mr. Hammit's, is in Section 974. It ends abruptly at a steep hill, facing north, where the land in that direction sinks to a low, broad valley, and all rocks are obscured by alluvium. To the southward the limestone strikes south with a little easterly trend, in Section 973, where it is partly obscured on low ground. It then rises on the other side of the valley (Section 967), passing over the ridge to Victoria Creek, and is seen on the Mount Crawford road, near the bridge which crosses the creek, also on road that goes north-easterly between Sections 966, 967. After passing the Mount Crawford road, the limestone seems to just pass into Mr. George Hammond's orchard (Section 1521), as the latter told me he had got some evidences of it in sinking a hole for one of his trees. Beyond this point it is not seen in the same line of strike, as the beds appear to be thrown by a dip fault a little to the eastward (as described below). At the termination of the limestone the latter is crushed and has a somewhat nodular structure, probably caused by the faulting.

Just above the bridge, near Mr. Hammond's, an outcrop of marble is exposed, in Section 966, and crosses the Victoria Creek in a width of about 100 feet. It seems to begin where the other outcrop of marble ends, having a lateral displacement, by faulting to the east, but continues on the same line of strike. A little higher up the stream the marble occupies the west bank of the creek, in a steep dip-slope, where the creek comes close to the road (dip N.E. at 70°). The stone is coarsely crystallized and highly charged with silicates in the form of bladed crystals. From its position at the creek the marble passes in a south-easterly direction through Sections 1521 and 965; then, for about half a mile, the ground is low and the marble obscured, but in Section 959 it once more forms a surface feature, and follows the rise on the western side of Springfield, the residence of the late Capt. Warren, and passes through Section 958, where it is 100 feet in width and has a strike N. 20° W.; it then crosses the district road and enters Section 3101, where it is cut off by schists. A strong outcrop of micaceous flags forms a conspicuous scarp-ridge on the eastern side of the limestone, the lowest portions of which are very siliceous and have been quarried in shallow pits all along the ridge for building purposes.

A small exposure of marble occurs on the eastern side of the last described outcrop of marble, near the late Capt. Warren's woolshed, but does not seem to go far. Its exact relation to the main line of marble is not very evident.

It is a little uncertain as to whether the respective outcrops of limestones (or marble) in this neighbourhood belong to the same geological horizon, or whether there are more than one limestone in the section. The break in the continuity of the main line of outcrop, near the bridge over the Victoria Creek, can no doubt be explained by the occurrence of a dip fault which has thrown the bed a little out of line. The more westerly limestone at Mr. J. S. Hammit's may possibly be a repetition of the main limestone outcrop by strike faulting, or the two parallel outcrops in that locality may represent distinct limestones at different geological horizons. In the latter case they would correspond to the Upper and Lower Torrens River limestones, as found in other districts. The more isolated outcrop on the western side of the main limestone, at Springfield, referred to above, cannot be placed in its true stratigraphical position at present.

The limestones of this district, especially near Springfield, and down to the district road on the southern side of Section 958, are greatly silicified, largely by metasomatic replacement of the calcium carbonate by silica and silicates. Opal, in white, brown, and yellowish-green varieties, occurs in abundance. It sometimes occupies the place of the limestone, and, at others, occurs along the borders. The limestone is sometimes intimately penetrated by silica in very fine reticulated veins, which, when the limestone is dissolved by weathering, appears as a delicate network, and so light as to become a float-stone, as occurs also with some of the marble beds at Angaston.

In the siliceous slates that overlie the limestone there is a small bed of quartzite, a few feet in thickness, which has been quarried along the line of outcrop from near the road to a position south of Springfield, where it swings round in dip from E. 20° N. to S.E. This occurs when in close proximity to important pegmatite intrusions.

(4) The Thick Quartzite.

The road from Williamstown, going eastward, passes the southern end of the Barossa Range, about three miles from the township. On the north-eastern side of Victoria Creek the ground rises through grass paddocks to a high ridge of quartzite which terminates abruptly on its eastern side in a steep and craggy face with large blocks of stone known as the "blue rocks," used locally for road metal. This is probably a fault face. The beds in the creek at the base of the hill showed a dip E. 20° N. at 35°. A quarry of similar stone, but not so strong, is seen on the opposite side of the creek, on the road, with a dip E. at 20°.

The main range bifurcates near the head of Tweedie's Gully, in Section 1104. The western limb passes south for two miles with a slightly eastern trend and ends at the "blue rocks" as described above. The eastern range, which forms the highest ground in the district, follows a course about 20° east of south, and is in alignment with Mount Crawford. In Section 50 there is a peculiar conical hill that rises, near the base of the main range, very abruptly to a height of about 100 feet above the common level. It is broken into immense blocks of stone composed of a medley of angular and subangular pieces of quartzite united by a ferruginous cement. It is probably a fault breccia connected with the faulting and bifurcation of the range. The ground between the two ranges consists of slates, or, rather, fine-grained mica schists, and is occupied by a creek and its tributaries. On the eastern side of the main range the dip was found to be E. 10° N. at 45°. The quartzites of the range are very similar in appearance to those near Adelaide. Clastic felspar (kaolinized) could be seen in some specimens, but on the whole they seemed to be somewhat more siliceous than the latter.

Mount Crawford.

The main range runs out a little to the southward of Mr. Murray Dawson's orchards, and there is broken country between it and Mount Crawford. On the eastern side of the main road, going southward to the mount, there are bold outcrops of rocks consisting of mica schists, often pegmatised. Mount Crawford is evidently an outlier of the main Barossa Range. It is a steep, conical, and isolated hill, with the South Para running at its base on three sides. The stone is a coarse, gritty quartzite, very siliceous, with much secondary silica introduced, which, in places, especially on the south-eastern side, converts the stone into a quartz rock. On the western side, near the base, the rock is brecciated. About half-way up the mount, on the western side, is a limited exposure of a speckled, schistose rock, carrying greenish and yellowish silicates, interlaminated with gritty bands. There is probably more of this rock than is visible, as there have been extensive landslides. On the southern side of the mount a similar speckled schistose rock is extensively developed in the bed of the river and its banks, showing a dip (or foliation) of E. at 30°.

The mount seems to owe its existence to the hard siliceous stone of the summit resting on softer beds. The latter have been cut into by the river, which has undermined the harder overlying beds, which, from inadequate support, have slipped down in extensive slides, leaving steep faces above and forming a kind of collar around most of the hill.

On the north-western side of Mount Crawford is an old saw mill, and not far from the east and west road is a very striking outcrop of rocks, like a wall, about 6 feet in height. This natural wall consists of a greenish quartzite, very hard and weather resisting. Strike S. 10° E.

(5) The Upper Limestone.

A limestone, higher in the series than those already described situated to the westward, outcrops on the eastern flanks and near the base of the greater Barossa heights. It has been proved when sinking drains in the orchards of Mr. Murray Dawson, "Wirra Wirra"; also on the road in front of his house (Section 674), and also in the adjacent grounds on the eastern side of the road. The limestone is of a highly siliceous composition, being more opaline than calcareous, but, in places, it takes the form of a marble carrying more or less silicates. The geological position of this bed in the series can be correlated with the blue-metal limestone which overlies the thick (Black Hill) quartzite in the Adelaide Series.

(6) The Upper Schists and Quartzite.

Overlying the limestone mentioned in the last paragraph is a thick development of mica schists and quartz-mica schists with minute black specks distributed through the stone. Small lenticles of pegmatite occur, occasionally, along the folia. At a distance of one mile eastward from the north-south road on which the limestone occurs, the road crosses the South Para in the bed of which fine-grained schists are well exposed in a strike S.S.E. and dip easterly at 45°.

At one mile eastward of the bridge (on the boundary line separating the Hundreds of Barossa and Para Wirra) the road divides, the right-hand branch goes to Mount Pleasant and the left to Springton. At half a mile beyond the junction of the two roads, on a slight rise, an outcrop of quartzite crosses the two roads in a north and south direction; the position is indicated on the map by the word "stone" in each case. The ground has not been opened out and the bed seems to be of no great thickness.

Following the road to Springton and taking the road to the left, which forms the dividing line between Sections 167, 168 (Hd. Para Wirra), the ridge

road was reached which divides the Hundreds of Para Wirra and South Rhine. A quarry in quartzite occurs on the left-hand side of the road, immediately on the boundaries of Sections 169, 170 (Hd. of Para Wirra), marked "stone" on the map. The stone is a white and soft quartzite and has been used for building purposes in Williamstown. [Mr. M. Dawson's house was built of stone from this quarry.] The stone can be followed from the quarry to the top of the ridge, where it is marked by very large surface stones. The dip of the beds is to the eastward, apparently at a low angle. Examined macroscopically the rock is seen to be a metamorphic quartzite, the granular portion having passed largely into flow structure and the mass frequently penetrated by fine quartz veins.

Correlation.

Adelaide Series in Type District.		*Adelaide Series at Barossa.*
Basal Conglomerates and Grits.	=	Basal Conglomerates and Grits.
Lower Phyllites Lower and Upper Torrens-River Limestones Lower Phyllites	=	Lower Mica Schists, etc. Crystalline Limestones Lower Mica Schists, etc.
Thick Quartzite at Black Hill, Stonyfell, etc.	=	Thick Quartzite at main Barossa Range
Upper Phyllites with Blue-metal Limestone Upper Phyllites	=	Upper Mica Schists, etc. Limestone with Opal Upper Mica Schists, etc.
Glen Osmond and Mitcham Quartzite	=	Metamorphic Quartzite at Eastern Borders of Hd. of Para Wirra
Thick Slates	=	Thick, fine-grained Mica Schists

2. The Adelaide Series on Western Side of the Axis.

(1) In the South Para (pl. i., fig. 2).

The junction which the Older (Houghtonian) Series makes with the Adelaide Series can be studied at its north-western limits in the South Para, near the deserted Barossa Gold Diggings, situated nearly due south from the Malcolm Barossa Gold Mine. The spot is reached by following the old track down to the former Menzies Barossa Gold Mine and the old crushing floors in G.S. 429 and G.S. 430, set back a little from the right bank of the river.

The track going down to the "floor" is close to the junction of the two series of rocks mentioned. The older is on the eastern side, and, on the western side of the track, is the ilmenite sandstone of the basal beds of the Adelaide Series sloping down to the creek on that side, bordered by granitoid rocks and, in places, penetrated by small granite veins.

At the crushing "floors" the Older Series is felspathoid and much decomposed. In the bed of the river these beds occur as highly metamorphosed schists, passing, at higher positions in the river bed, into granitoid rocks and thick augen gneiss with contorted structures, the latter quarried in Section 177, as already stated.

The Basal Grits are exposed on the western side of the "floors" in a very massive outcrop. The rock is rather fine in the grain and shows numerous layers of clastic ilmenite laid down by current-bedding. The strike is nearly north and south, and the dip, near the western side of the exposure, W. at 40°. The lode, or perhaps a series of lodes, of the Menzies Barossa Mine, appears to

be in these grits near the junction which they make with the Older Series. The grits have a face of about 150 feet to 200 feet in width and can be followed down to the river. In the bed of the river the dip is westerly, at 52°. On the southern bank the grits form a very strong and bold face, making a prominent spur jutting into the river, and is locally known as the "devil's nose," a name that seems to have been suggested by the profile of the crags when viewed from a little distance down the river. The grits on this side appear to be disturbed, and are almost vertical, in part. There is a sunken area near the centre in the direction of the strike which may be caused by the lode formation.

QUARTZITE, PHYLLITES, AND "BLUE METAL." Going westerly the grits are overlain by a fine-grained siliceous quartzite with a dip W.S.W. at 46°, which is probably the upper members of the basal beds. These, again, are overlain by a thick series of phyllites, much contorted, with a dip, taken near the base of the beds, of W.S.W. at 64°. The phyllites continue up to the outlet of a small creek, on the right bank of the river, about half a mile distant from the "devil's nose." The creek, just mentioned, is the same as seen on the right hand of the track going down to the mine. Shortly before reaching the outlet of this creek there is an acute anticline in a "blue-metal" zone in the slates. Going up the small creek, at a distance of about one-eighth of a mile from its outlet, the "blue-metal" rock forms a cliff on its eastern bank 20 feet in thickness. Outcrops of what is probably the same rock occur higher up the creek in the form of an impure blue limestone, 6 feet in thickness, followed by a calcareous rock consisting of impure siliceous limestone and dolomitic limestone. Rising from beneath the limestone are the slates and quartzites that are exposed in the river below. In Section 109 the quartzite has a dip S.W. at 76°.

MORE QUARTZITES, PHYLLITES, AND LIMESTONES. The small tributary creek, just referred to, marks the division in the direction of the dip. On the eastward side of its outlet the dip is westerly, which is normal; from this point, to the westward, the dip is easterly, or inverted, at a high angle. After passing the outlet of the small creek, on the eastern side of Section 111, a coarse-grained quartzite follows in the section with a strong rocky face, 150 feet in height, having a dip E. at 40°, and about 200 feet in thickness. This quartzite is followed by more contorted phyllites containing a smaller quartzite. Near the southerly bend in the river, in Section 111, there is another "blue-metal" zone in the phyllites with a dip easterly up to a high angle. Before reaching the district road that forms the western boundary of the same section, another quartzite makes its appearance, about 80 feet, or more, in thickness, with a local dip (in part) W. at 80°. The latter passes on its western side into a soft whitish quartzite with reversed dip E. at 20°. Quartzites are on the district road referred to above, and these make conspicuous outcrops on the road that defines the northern boundary of Section 110, forming the slopes down to the river in Sections 107 and 111, with a strike N.N.W. Underlying the quartzite is a calcareous slate and crystalline limestone streaked by veins of calcite. The limestone is nearly vertical, with a slight easterly dip, and shows a steep face to the river, on its northern bank, having a thickness of about 40 feet. This limestone can be traced, at intervals, in a north-south direction to the Tenafeate Creek in a distance of nearly four miles (see p. 14). Phyllites underlie the limestone to the westward, and at 150 yards from the latter another "blue-metal" zone occurs, following which the phyllites, with a general dip to the eastward, continue to the great bend in the river in Section 1787, Hundred of Munno Para. At one place in the phyllites, not far from the "blue-metal" zone, a very black rock occurs with included fragments of a thin-bedded blue limestone. The matrix is earthy-calcareous, and the rock, as a whole, autoclastic.

(2) In Waterfall Gully and Tenafeate Creek (pl. i., fig. 3).

The section is taken $3\frac{3}{4}$ miles to the southward of the South Para and parallel with the latter. It begins on the western margin of the Humbug Scrub, about the centre of Section 101 (Hd. of Para Wirra), in a small watercourse known as the Waterfall Gully, on the property of Mr. H. H. Blackham, of Trevilla, near One Tree Hill. The Waterfall Creek is a tributary of Tenafeate Creek, which it enters on its right bank. As in the South Para the beds are at a high angle, and mostly inverted by a dip to the east instead of to the west, which latter would be their normal inclination. The rocks (particularly the slates) are greatly contorted, giving evidence of crush, which sometimes takes the form of a crush-breccia.

The Fundamental Rocks have a close lithological resemblance to beds of this age as they occur in the South Para, described above. They form a part of the western limits of the greatest exposure of these rocks known in South Australia, and at the point where our present section begins they have a width of four miles. Along its western margin the rock is a fine micaceous schist, intimately penetrated by thin and scarcely discernible laminae of pegmatite. Going eastward the pegmatite constituent becomes more marked and the rock takes on a pinkish colour from the presence of coloured felspar. In places there is so little mica present and so much felspar that it is near to a syenite. The pegmatite element in the rock gradually increases to the eastward in the form of distinct intruding veins, some of which are of considerable size. The line of junction with the newer (Adelaide) series can be traced, northwards, across Mack's Creek to the South Para River, a little to the eastward of the "devil's nose" [Section 3280, Hd. Para Wirra].

The Basal Grits of the Adelaide Series rest unconformably on the Older (Houghtonian) Series, and, although they do not contain large rounded pebbles, are quite characteristic. Near the base the grain is coarse and of an arkose character containing very distinct crystals of felspar, which are often angular and as large as a pea, or larger. Quartz is abundant in detached grains and is sometimes waterworn. Clastic ilmenite occurs in dark-coloured streaks often accompanied by current-bedded structure. There are no prominent surface features to mark the division between the Basal Grits and the Older Series, the creek having worn the two sets of beds down to a common level, but the lithological features are distinctive.

Slightly above the waterfall is a slate, a few yards in width, which separates the coarser grits from a rock of finer grain. This bed of slate is not well seen, as it is mostly covered with soil.

At the waterfall there is a white, softish, felspathoid freestone, very similar to the Aldgate freestone which forms the upper portions of the basal beds in that neighbourhood. The stone is massive, current-bedded, and much jointed. The dip is somewhat obscure but, apparently, a little to the south of east at 35° or 40°. This freestone is classed as the upper member [reversed] of the Basal Grits. The creek has cut its way down from a great height in these beds, which from their relative hardness have held up the stream in a waterfall about 18 feet in height. It has already receded in these beds to a length of 90 feet, and the beds, with the "grits," continue above the falls to a further distance of 230 feet. A few yards above the falls are two deep potholes in the bed of the stream.

Lower Thick Slates or Phyllites. Immediately below the white freestone is a thick set of slates which, measured by stepping, shows an exposure of 325 yards. At the plane of contact with the freestone mentioned, these slates have a dip of 35° easterly, which gives the appearance of their dipping under

the latter, which, indeed, they do, but only in consequence of their inverted position. At a distance of abut 100 yards from the waterfall the slates become much disturbed and contorted.(1) They are bent into a small anticline with a nearly vertical dip. In a further 50 feet, in cross section, the dip returns to E.S.E. at 65°, and shortly before reaching the junction which the Waterfall Creek makes with the Tenafeate Creek the dip is 40° in the same direction.

At the place where this small creek joins the Tenafeate Creek, the latter, for a distance of about 200 yards, runs parallel with the strike. On the right bank of the creek is an interesting rock that may be described as a *white, saccharoidal, calcareo-siliceous rock*, having a thickness of about 90 feet. It is seen in section at the junction of the two creeks, and also at the sharp bend of the Tenafeate Creek, where the latter once more takes a westerly direction across the strike. When tested by HCl the removal of $CaCO_3$ leaves behind a skeleton of SiO_2 which is transparent in small pieces, feebly held together, and easily crushed between the fingers. The rock gives evidence of metamorphic action. In correlation with the South Para Section this bed is represented by the "blue-metal" limestone in the small creek on the western side of the Menzies Barossa crushing floors.

On the western side of the calcareo-siliceous rock the slate beds reappear in the section with a further exposure of 80 yards.

Middle Quartzite. The slates on their western side pass gradually into a fine-grained siliceous quartzite at a high angle of dip that reaches the vertical with a local variation (in part) that gives a dip to the west at about 80°. In the bed of the creek it is laminated and divided up into bedding a few inches in thickness. It has a width of 90 yards.

Second Thick Slates with Two Zones of "Blue-metal" Limestone. Between the quartzite just described and the thick slates that follow is a quartz reef, mottled with a pinkish colouring, and, about, from 2 feet to 5 feet in width. The slates are of a uniform character for 250 yards, when a "blue-metal" limestone, 8 yards in thickness, occurs in the series; the beds are vertical and much contorted. Then follow 40 yards of slate, also much contorted, and another "blue-metal" zone, 7 yards in thickness, situated at the outlet of a small creek on the right bank of the main creek. On the opposite, or southern side of the main creek, the "blue-metal" rock is exposed in the bed of a narrow gorge for a considerable distance up the hill on that side, the gorge having been eroded directly on the strike of the beds.

Second Thick Quartzite. Following on the "blue-metal" zone, at the outlet of small creek, a quartzite puts on at the western side that has a spread of 130 yards. Near its western limits it is a white felspathoid rock with a dip E.S.E. at (?) 35°, which passes into a fine-grained and siliceous quartzite. The same stone is on the opposite bank of the Tenafeate Creek, where, in Mr. Blackham's quarry [Section 5666], it has been worked for building stone; dip easterly, at 80°.

Slate with "Blue-metal" Limestone. To the westward of the quartzite, last described, the valley of Tenafeate Creek widens out and carries more alluvial cover, so that the geological succession becomes less distinct. The rock exposures, although weathered at surface, are better seen on the southern side of the valley than on the northern. The quartzite is succeeded by slates that include a "blue-metal" zone, which latter passes up the southern bank of the stream, through

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(1) A specimen showing the remarkable contortions in this rock was forwarded to the University of Adelaide by Mr. H. H. Blackham.

Mr. Westley's herb garden, in Section 312, the slates and blue-rock combined having a thickness of about 300 feet.

GREY-COLOURED "MARBLE." Following the slates, just described, a light-coloured dolomitic limestone outcrops on the roadside going down to Mr. Westley's residence. The stone, which is estimated to be about 50 feet in thickness, varies in colour, usually either white, grey, or buff. The lighter-coloured examples have a porcelain-like appearance, are much jointed, and are often marked by dendrites. It can be traced to the southward of this spot in isolated blocks on Mr. Blackham's property, and can be traced northward, at intervals, to the South Para, where it crosses the stream from Section 1026 (Hd. Para Wirra) to Section 107 (Hd. Barossa) [see *ante*, p. 11]. In Section 1701 (Hd. Para Wirra) it has been subjected to several successive overthrusts, at right angles to the normal strike, which are well seen in the face of the hill to the westward in the Section mentioned. In this Section a fragment has been thrown fully a quarter of a mile to the westward of the main body of limestone, and occupies the slopes down to Tenafeate Creek, where the latter forms the boundary between the Hundreds of Munno Para and Para Wirra. The marble on Westley's road dips, apparently, E.N.E. at 50°.

FURTHER SLATES AND ANOTHER "BLUE-METAL" LIMESTONE. To the westward of Westley's the bed-rock is, within a short distance, obscured by alluvial deposits, but, succeeding the "marble" bed, grey slates can be noted, and near the bottom of the hill-slope some slight indications of another blue limestone bed show through the surface soil, shortly before reaching a natural spring in the bank side.

Mr. Gavin Scoular has recorded the occurrence of several limestones in the Hundred of Munno Para, which carries the section still further in a westward direction from the point where the present section ends (1).

IV. NOTE ON THE COUNTRY TO THE SOUTH OF WILLIAMSTOWN.

The main north road from Gumeracha, through Forreston, is in the Older Rocks, mostly in aplites. The same rock continues through Horse Gully, where there has been much alluvial prospecting. A change in the geological features occurs in the Blockers' Sections, situated a little to the north-west of Horse Gully (a central position in the Hundred of Para Wirra). On the top of the hill, on road situated to the southward of the Blockers' Sections, there are outcrops of the ilmenitic grits of very characteristic type. They occupy the spur going north and appear on the opposite side of the valley beyond the Blockers' settlements [strike N. 20° W.]. The hills on the right consist of the Older Series, but I have reason to think that the basal grits and conglomerates are present to the north-east in Section 116 (Hd. of Para Wirra). This outcrop of the ilmenitic grits is situated about two miles to the southward of the South Para and almost due south from Williamstown.

V. SOME TECTONIC AND STRATIGRAPHICAL FEATURES.

The geologic succession on the eastern side of the main axis, from near Williamstown to the eastern boundary of the Hundred of Barossa, can be correlated with the Adelaide Series as seen on the western side of the ranges near Adelaide. The sediments in their leading characteristics and bedding are similar, and the dip in each case is normal, being directed away from the main axis. The main difference is in the eastern section being more highly metamorphosed and intruded than the western.

The succession on the western side of the axis, as seen in the South Para and several creeks, while agreeing in a general way with the type district, further south, is somewhat aberrant. In the South Para section the beds show a normal dip in relation to the axis, dipping to the west for about half a mile, beyond which the beds are reversed and dip easterly. In the Waterfall Creek and Tenafeate Creek the beds are reversed throughout, having the appearance of dipping under the Older Series. The cause of this reversal is not easy to determine. The push evidently came from the east and forced the beds first into a vertical position, and was then carried a stage further, when the beds became more or less inverted. It is possible that there were two factors concerned in this movement: the first in the form of a thrust from the east, which raised the beds on end, and then, possibly, this movement may have been followed by a gravitational pitch over to the westward, from lack of support on that side, there being a steep fault slope on that side at the verge of the great rift valley. The movements have been attended by great dislocations and crush phenomena involving, probably, a repetition of beds, which, on account of the high dip and inversion, is not easy to recognise. In Mack's Creek, about midway between Tenafeate Creek and the South Para, there is a thrust-plane in the slates, near the bottom of the series, which has entirely broken up the slate into angular pieces forming a thrust-breccia.

A special feature of the beds on the western side is the repeated occurrence of impure calcareous zones in the slates. They are for the most part of a dark-bluish colour and not very sharply defined in the bedding. They have for convenience been called "blue-metal" limestone, on account of their similarity to a bed, so called, that has been extensively worked in the face of the foot hills, near Adelaide, and used for road metal in the eastern suburbs. This bed occurs in the Upper Phyllites, between the Black Hill quartzites and the Glen Osmond and Mitcham quartzites. There is also a very similar stone in the Lower Phyllites described as the Upper Torrens-limestone [see Howchin (12), p. 6, and (13), p. 356], in which there is a good deal of chert. It is probably with the latter rather than with the blue-metal limestone of the Upper Phyllites that the beds so designated in the present paper should be correlated.

Typical examples of the "blue-metal" limestone from the Tenafeate Creek section were treated with HCl by which the calcareous content was removed by solution. The residue was a black-coloured skeleton that could scarcely be handled without it falling to pieces. This was subjected to the blow pipe flame, and the black colouring matter, which is evidently carbon, was discharged, leaving a white skeleton of silica indistinguishable from that left by a similar treatment of the white saccharoidal calcareo siliceous rock in the Tenafeate Creek described above [p. 13].

A sample of the white dolomitic "marble"-like limestone that occurs at the western end of the section, on Mr. Westley's road, was similarly treated, and with similar results; the chief difference being a higher percentage of calcium carbonate with a corresponding lower proportion of silica that is very slightly coherent.

ACKNOWLEDGMENTS.

I am indebted to Mr. H. H. Blackham, whose knowledge of the country around Tenafeate Creek has been of much service to me; also to Mr. H. J. Spencer, headmaster of Williamstown Public School; Mr. Murray Dawson, "Wirra Wirra"; and Dr. Pulleine, for motor facilities in examination of the country around Williamstown.

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DESCRIPTION OF PLATE I.

Fig. 1. Sketch-section on eastern side of the Geological Axis in the Hundreds of Barossa and Para Wirra.

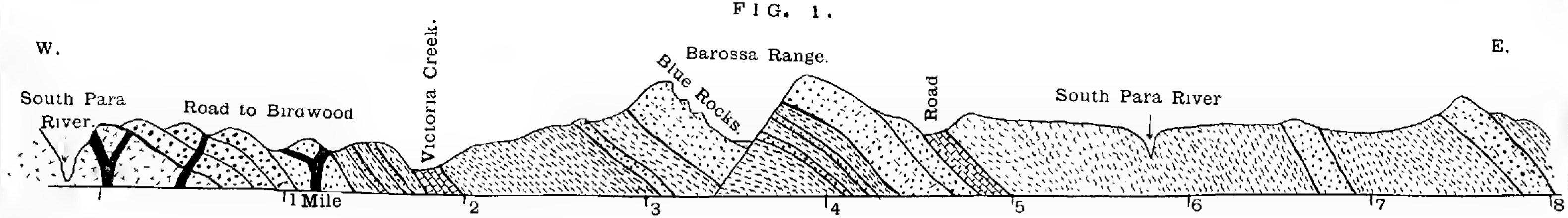
Fig. 2. Sketch-section on western side of the Geological Axis along the northern banks of the South Para River.

Fig. 3. Sketch-section on western side of the Geological Axis from Humbug Scrub *via* the Waterfall Gully and Tenafeate Creek.

GEOLOGICAL SKETCH-SECTION OF THE BAROSSA RANGES AND NEIGHBOURHOOD.

By PROF WALTER HOWCHIN, F G S

FIG. 1.



SKETCH SECTION ON EASTERN SIDE OF THE GEOLOGICAL AXIS IN THE HUNDREDS OF BAROSSA AND PARA WIRRA DISTANCE, 8 MILES.

LEGEND.

Slates, Phyllites, or Mica Schists

Quartzite.

"Blue-Metal" Limestone.

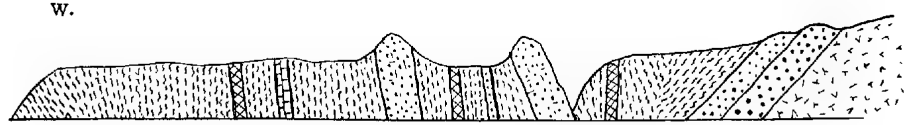
Limestone or Marble.

Basal Grits and Conglomerates.

Fundamental Complex.

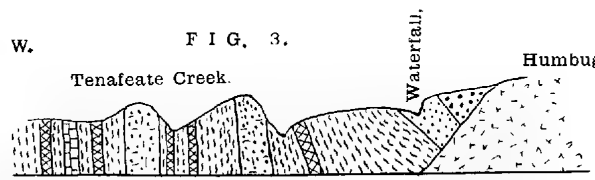
Intrusive Rocks.

FIG. 2.



SKETCH-SECTION ON WESTERN SIDE OF THE GEOLOGICAL AXIS ALONG THE NORTHERN BANKS OF THE SOUTH PARA RIVER DISTANCE, 2 MILES

FIG. 3.



SKETCH-SECTION ON WESTERN SIDE OF THE GEOLOGICAL AXIS FROM HUMBUG SCRUB *VIA* THE WATERFALL GULLY AND TENAFEATE CREEK.

Gillingham & Co. Limited, Printers, Adelaide.

RELICS OF ABORIGINAL OCCUPATION IN THE OLARY DISTRICT.

By D. Mawson, Kt., D.Sc., F.R.S., and P. S. Hossfeld, B.Sc.

[Read April 8, 1926.]

Plates II. and III.

CONTENTS.

1. Introductory Remarks.

These notes refer to the neighbourhood of Olary, a point on the Adelaide to Broken Hill railway line in the north-eastern portion of the State. The extensive broken country of the Outalpa Hills and the Boolcoomata Hills, northward of the railway in that vicinity, offer, to primitive races, special attractions such as water facilities in the nature of unfailing springs and rock-holes; also abundant shelter-caves and plentiful game. Thus it is that there are numerous relics of aboriginal occupation, though the natives themselves have disappeared.

In the year 1892 there were still about 50 natives camped near Olary.[1] Their chief was known as Outalpa George, a notice of whose death appeared in the Adelaide papers some time later. About the date mentioned they all migrated to Poolamacca Station, in the Barrier Ranges, some 45 miles north of Broken Hill. For many years, and until quite recently, Poolamacca Station, under the *régime* of the late owner, Mr. J. Brougham, constituted a sanctuary for the last remaining aboriginal inhabitants of the Barrier Ranges and adjacent areas.

From the granite summits of Boolcoomata Hills, the Barrier Ranges, in New South Wales territory, and a half-way stage to the Darling River, can be clearly observed rising above the eastern horizon beyond the intervening saltbush plains. From the northern Barrier Ranges, the rugged ridges of the ranges extending from Mootwingee[2] to Gnalta can be seen to the east. Communication between the native inhabitants of these several rocky ranges could be easily effected. From the Barrier Ranges and the Mootwingee area the gum creeks, natural courses of native migration, lead to the Darling River.

To the west of Olary, on the other hand, there is little break in the hilly topography right across to the Flinders Range. Thus one would naturally expect also some relationship between the natives of the Flinders Range and the area under consideration. From evidence to hand, however, it would appear that the natives of the Outalpa and Boolcoomata Hills actually belonged to the Darling River tribes, and to that part of them which spoke the Marowra language.[3]

(1) Information communicated by Mr. W. Coulston, of Bimbowrie Station.

(2) See paper by R. Pulleine on "Native Paintings at Mootwingee," Proc. Roy. Soc. S. Austr., vol. l.

(3) Curr, "The Australian Race," vol. ii., pp. 173-185 and pp. 226-241.

This is indicated by such local place names as the following, the interpretation of which in the Morowra language[4] is that appended herewith:—

Taltabooka (dead kangaroo)
Yerka (thirsty)
Mutooroo (grass snake)
Kalkaroo (war spear)
Pimpena (big pine)
Kalabity (one egg)
Bimba (pine tree)

The relics of native occupation that have come under review are of three forms, namely, first, rock paintings in cave-shelters; second, vestiges of camp sites; third, piles of loose stones of ceremonial significance.

2. Rock Paintings.

Though some fine examples of native art occur thereabouts no reference[5] to such can be traced in print, excepting a mention of intaglio rock carvings reported in the year 1902 in a letter to the South Australian Museum, written by Mounted Constable Waterhouse, as existing near Mannahill, which adjoins Outalpa on the west. Details of Waterhouse's letter, which is still preserved in the S.A. Museum, are given in a recent article[6] by Hale and Tindale. From this letter the following quotation is taken:—"I am sending part of a native tatoe of a kangaroo track, which I obtained whilst on my leave near Manna Hill, where I know of numerous tatoes, or rock carvings, of the natives, some of which are very well done." It appears that the late J. G. O. Tepper examined the slab of carved rock sent down and erroneously attributed[7] and reported the pitting of the rock to be the "effect of certain algae and lichens." Though we have not seen examples of this intaglio work in the Olary district, we have had several examples of rock painting brought under our notice by Mr. W. Coulston, a description of which follows herewith.

(a) The Castle Rocks Cave.

The most accessible of these is within two miles of Old Boolcoomata Head Station, in a cave shelter uniquely situated in a boldly outcropping jumble of rocks, several acres in extent, which we named Castle Rocks when executing a geological reconnaissance of the district. These rocks stand up in strong relief, to a height of 100 feet or more from the bottom of a narrow valley depression eroded along the south side of the gigantic granite mass of Binberrie Hill.

Castle Rocks are themselves composed of sedimentary rocks crushed and metamorphosed by the granite intrusion. The valley in which this pile of rocks occurs is a convenient and natural pass, now occupied by a road, leading through the rugged granitic country of the neighbourhood. The castellated pile of rocks (pl. ii., fig. 1) stands sentry dominating the pass.

Situated in the heart of the mass, at a point below the summit, is a rock shelter, so well hidden away that it is possible to climb over the rocks without observing its presence. This is so because it opens, not on to the exterior face of the pile, but is situated on the southern face of a deeply eroded narrow groove, which runs from the eastern extremity of the rocks into the centre of the mass and there terminates abruptly. The ascent to the cave by any way but along this groove is a matter of steep climbing. On the other hand, the rocky floor of the

(4) P. W. Schmidt, "Die Gliederung der Australischen Sprachen," pp. 45-47 and 51-57.

(5) Still further to the west, at Yunta, Dr. H. Basedow has described a case. See "The Australian Aboriginal," Preece & Sons, Adelaide, 1925, pp. 303 306.

(6) The Records of the South Australian Museum, vol. iii., No. 1, p. 52.

(7) Roy. Soc. S. Austr., vol. xxvi., 1902, p. 326.

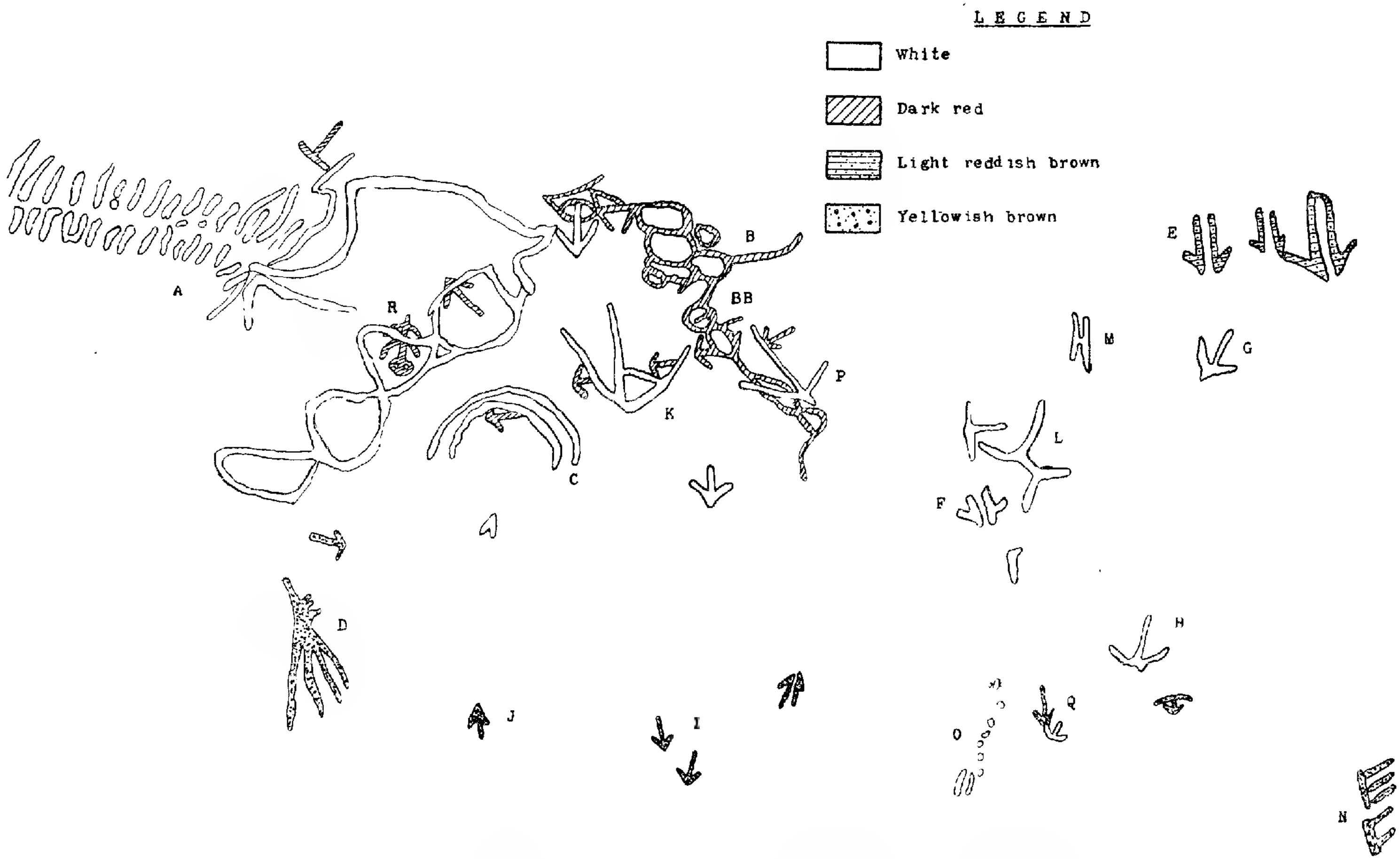


Fig 1. Mural design in the Cave Shelter at Castle Rocks.

groove ascends as a natural ramp. The location as a fortress could not have been better selected. Improving its natural advantages in this respect is the existence near the summit of one of the larger rocky heads and directly above the cave itself, of a natural rock pool into which runs all the rain water falling upon a considerable area of rock face nearby.

The cave, a view of which appears as pl. ii., fig. 2, faces north and is about 25 feet in width and 12 feet high in front, tapering inwards to a depth of about 10 feet. It is floored with a bed of river sand, evidently carried there by human agency with a view to making it more comfortable to lie upon. On the south or back wall are the drawings executed in colours.

A camera-lucida drawing of a photograph of these appears as text fig. 1 herewith. By this method a very good record has been obtained, drawn to scale. Included amongst the forms represented are tracks of emus and other birds (items G to J), of kangaroos (item E), and rock wallabies (item F). The partly barred circle (item BB), and the double semicircle (item C) occur in other localities, and were evidently of significance to the natives.

In this rock shelter, as in all others examined by us in the district, a number of different colours were employed in the designs, but in every case each separate drawing was executed in a single colour. Further, no background colour was employed as reported [8] of the native practice in certain portions of Central Australia. Our observations show that in the Olary district different colours were used by successive artists or at successive periods by the same local artists. The overlapping of design in one colour upon those of another clearly define the relative period of execution. In this superposition of colours, each colour appears to have been used at some definite period and never again. The succession of colours, however, varies in each cave, and may thus have depended more upon individual choice than accidents of supply.

A feature indicated by these drawings is that the designs as a whole appear to have definite meanings, and are probably to be regarded as more than a fortuitous collection of separate drawings. At Castle Rocks the dark-red, the light-reddish-brown, and the yellowish-brown colours each occupy a separate portion of the wall. Each colour doubtless represents the work of a different artist, and it is very likely that the whole of the drawings were executed at four sittings only, either by the same or, more likely, by different artists. On each occasion the artist appears to have selected a part of the wall large enough to allow his drawings the spacing which they require. On this assumption a certain definite distance apart of the items in the design was necessary to convey the group meaning, a feature which appears more particularly to be shown by the white drawings. These latter are executed across the previously existing drawings even in cases where (as in items C, K, P, and Q), there was ample wall space to place them elsewhere.

(b) The Bimba Rock Shelters.

Two other rock shelters embellished by native artists were examined on the slopes of Bimba, a magnificent granite hill about 10 miles north-west by north of Castle Rocks. The hill is elongated in a north and south direction, its summit stands quite 500 feet above the neighbouring lowlands, and its sides are of the nature of very steep slopes. So steep are they that enormous weathered slabs and boulders of granite have slid down from above and notably encumber the lower slopes. Arid weathering has developed extensive shallow caves under some of the large platy exfoliations of the rock, particularly noticeable on the western slopes.

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(8) See Spencer and Gillen, "The Native Tribes of Central Australia," Macmillan & Co., London, 1899; Basedow, Trans. Roy. Soc. S. Austr., vol. xxviii., pp. 12-52.

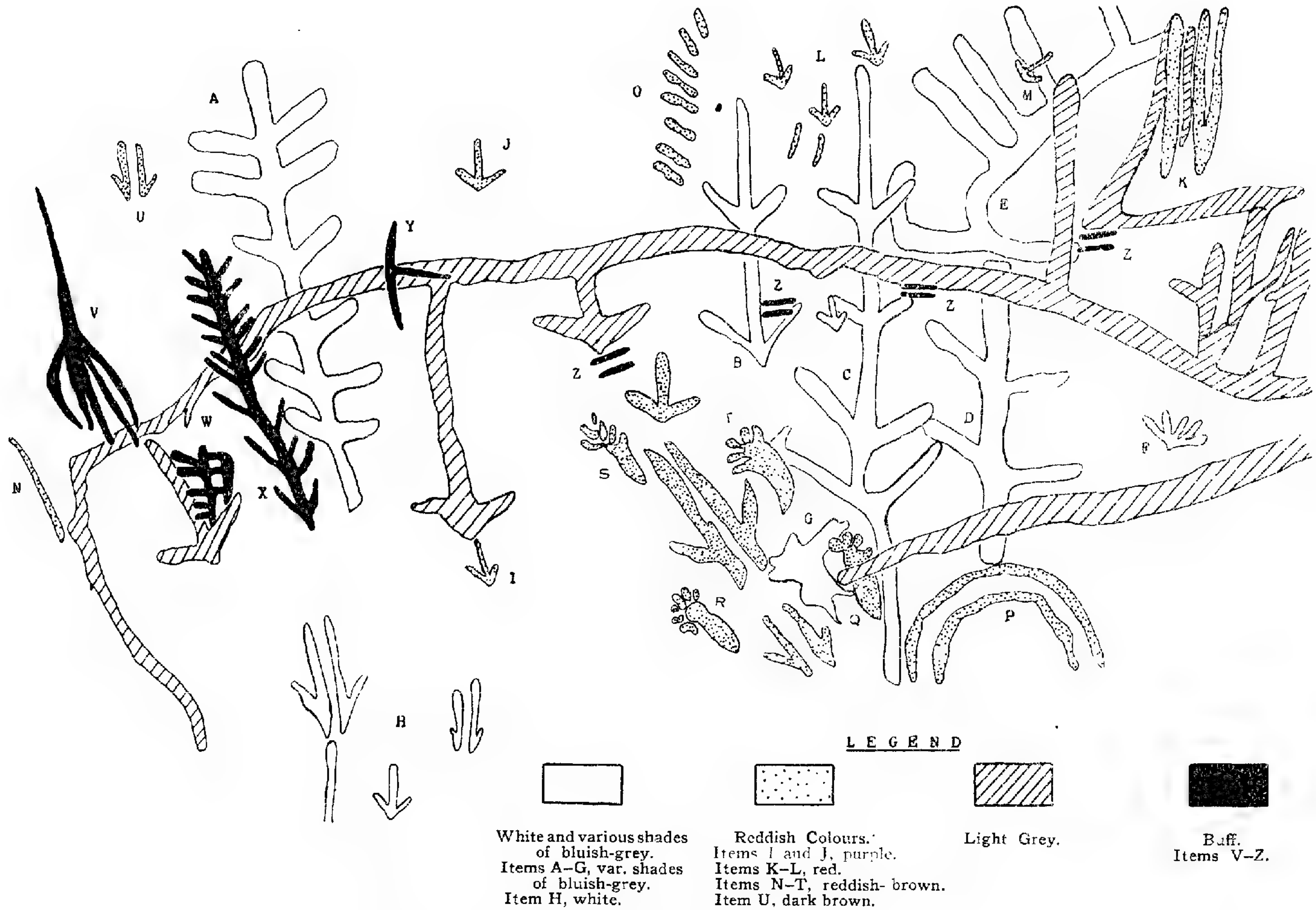

Fig. 2. Mural Design in a Rock Shelter at Bimba.

On the eastern side weathering has gone on under many of the large rolled, tor-like, granite masses, particularly on their eastern and south-eastern sides (pl. iii., fig. 1). These rocks have become case-hardened above, where the heat of the sun is felt; but on the shaded, and consequently damper, side, disintegration has gone forward with the development of cave-like shelters. In two instances the walls were noted to be covered with an intricate network of designs superimposed one upon the other. For wealth of design the Bimba shelters far transcend that at Castle Rocks.

One of the former is located not far above the valley floor in a run of enormous granite boulders which were found to measure up to 40 feet by 24 feet by 24 feet. This cave is well stocked with drawings, but is not so interesting as another situated about 100 yards further up. A camera-lucida drawing of a portion of the decorated wall of this upper shelter constitutes text fig. 2. Here many of the forms represented in the Castle Rocks cave appear once more; but in addition are several others of distinct and suggestive design such as the human foot tracks of the group, items Q to T. It is possible that the forms A, B, C, D are intended to symbolise the Calitris pine trees which are a distinctive feature of the upper slopes of Bimba, and so strikingly different from the usual acacia and eucalypt vegetation of the region.

The number of drawings on the wall of this cave are so numerous and some of them so faint through age and superposition that only the more outstanding ones have been figured. Here, as in other caves, care must be taken to eliminate adventitious drawings and script contributed by sundry visitors in recent years. There is no difficulty in distinguishing such defacements.

A wider range of colours has been employed in this Bimba cave, amounting in all to about nine distinct colours. The succession of colours is as follows:—1, various shades of bluish-grey; 2, white; 3, purple; 4, red; 5, reddish-brown; 6, light brown; 7, dark brown; 8, light grey; 9, buff.

In the Bimba Caves, also, each drawing was executed in one colour only, and the particular colours were used in each case exclusively at one definite period.

The drawings such as have come under our notice in the Olary district, when compared with those in the Flinders Range to the westward, are very primitive, as is shown by the use of a single colour for each drawing, by the objects depicted, and by the rough execution of the designs. This appears to suggest no close relationship with the tribes of the north Flinders Range.

3. Camp Sites.

The remains of native camp fires are known in various localities in the district. They are well illustrated over an area of several acres of alluvial, red clay flat at a bend in the gum creek a mile below Maldorky Well. This is some 17 miles due south-east of Olary. The sites of old camp fires show up as pebble mounds, somewhat weathered out in relief, along the flat on the southern bank of the creek. This was evidently a favourable camping place, as indicated by the quantity of remains thereabouts. It appears not unlikely that a main native traffic route from the north-east to the vicinity of the Burra passed by here, for its geographic features make it an easy line of communication. Indeed, this fact has located the main track for vehicular traffic to the north-east along these plains somewhat to the south of this old native encampment.

The stones used by the natives in their cooking operations have protected the clay-loam from deflation under arid aeolian conditions, causing the various old

fire sites to stand out in relief above the general level. Usually some charcoal can be found by scratching away the soil between the stones. Occasionally this charcoal layer is as much as an inch in thickness. Lumps of white reef quartz, abundant everywhere in the Olary district, occur amongst the fire stones. A feature of special interest, likely to be useful in future as a criterion of fire stones, is the fact that the heat to which they have been subjected has cracked the quartz pebbles in an intricate fashion, rendering them quite distinct from the normal, uncracked, shoaded, quartz fragments so commonly occurring in the neighbourhood. Dust and oxides of iron have penetrated the cracks, strongly outlining them. The low coefficient of expansion and the homogeneity of the quartzes have saved them from entirely bursting asunder as must happen in the case of many other varieties of rock.

4. Pebble Mounds.

In his letter [9] Mounted Constable Waterhouse refers to the occurrence of pebble mounds in the Outalpa area, but gives no details thereof. We had our attention drawn to two examples by Mr. W. Coulston. An old and somewhat dilapidated one is to be seen about half a mile to the north of the Old Boolcoomata Station buildings, on the right hand side of the track to the Yerka Well. A much better example is on the divide between the valley just west of the Binberrie Road at the turn off to Old Boolcoomata Station, and the Ameroo Springs Valley, which lies just north of the former. It is distant about 2 miles in a south-west direction from the turn off mentioned. The photograph (pl. iii., fig. 2) gives a good general view of the conical mound. Its average height is about 3 feet 10 inches, and diameter at the base 24 feet. It is composed of stones of all sizes up to about a foot in length, but the average size appears to be about 18 cubic inches. The number of stones if the entire mass were solid would therefore be about 55,488. An allowance of about one-third for spaces between the pebbles should suffice. There is, therefore, represented in round numbers about 37,000 pebbles. We were told that such mounds are not infrequent in the district and that they were built up by the natives, each throwing a stone on the piles, which are always situated on the cols between two valleys, as they passed from one valley to another, the idea being to allay the evil spirits from following them across from one valley to the next.

Addenda.

We find that there are a few native relics from this district preserved in the South Australian Museum. Included are three cylindro-conical stones, two unhafted stone axes, and a boomerang.

Since the reading of this paper, we have received the following reports of further native relics in that neighbourhood. From Mr. W. Coulston:—"I know of several big camps in a fair state of preservation, also drawings in small caves in a creek about 1½ miles north-west from Binberrie Hill. . . . I have been told that there are several caves with drawings at what is locally known as Picnic Springs. These springs are about 3 miles from Bimbowrie, on Outalpa run."

From Mr. H. E. Ding, of Olary:—"I am informed that there are rock carvings near Outalpa Springs, consisting of emu and kangaroo tracks." Mr. Ding also remarks that the painting of a man in a cave high up on Bimba Hill is not the work of natives, but of a local prospector.

[9] Letter referred to by Hale and Tindale. See 6.

DESCRIPTION OF PLATES II. AND III.

Plate II.

Fig. 1. A general view of the more central part of Castle Rocks viewed from the north. As giving some idea of the scale of this mass it should be mentioned that the speck on the apex of the triangular block of rock on the sky-line in the centre of the picture is Mr. Hossfeld. The cave is situated directly behind the triangular block well hidden away in a deep, blind-ended groove opening only to the east.

Fig. 2. View of the Castle Rocks cave shelter, seen opening on to the deeply-cut groove.

Plate III.

Fig. 1. A run of enormous rolled boulders on the eastern slopes of Bimba Hill. The Bimba rock shelters with paintings are situated in and under these gigantic masses. The scale of the picture is indicated by the figure of Mr. Hossfeld standing on the summit of the smaller boulder which stands in front of the largest block in the view (with a dark cave showing up on its lower side) seen near the left-hand top of the picture.

Fig. 2. A pebble mound on a col between the Ameroo Springs valley and the next valley to the south, Outalpa run.

Fig. 1. General view of Castle Rocks from the North.

Fig. 2. Rock Shelter at Castle Rocks.

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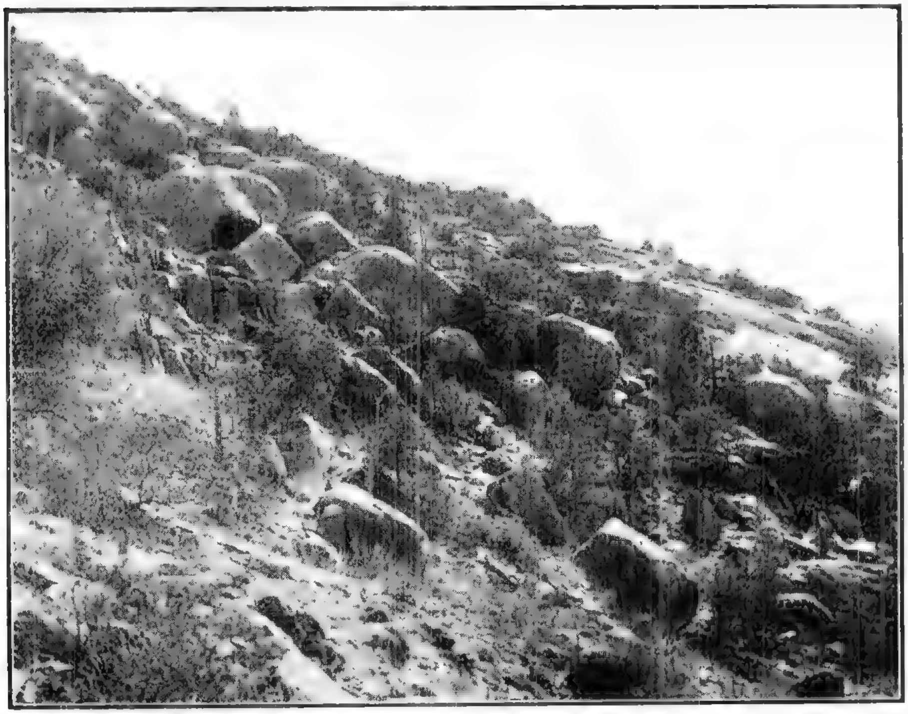

Fig. 1. Enormous rolled boulders on the slopes of Bimba. The locus of several decorated Cave Rock Shelters.

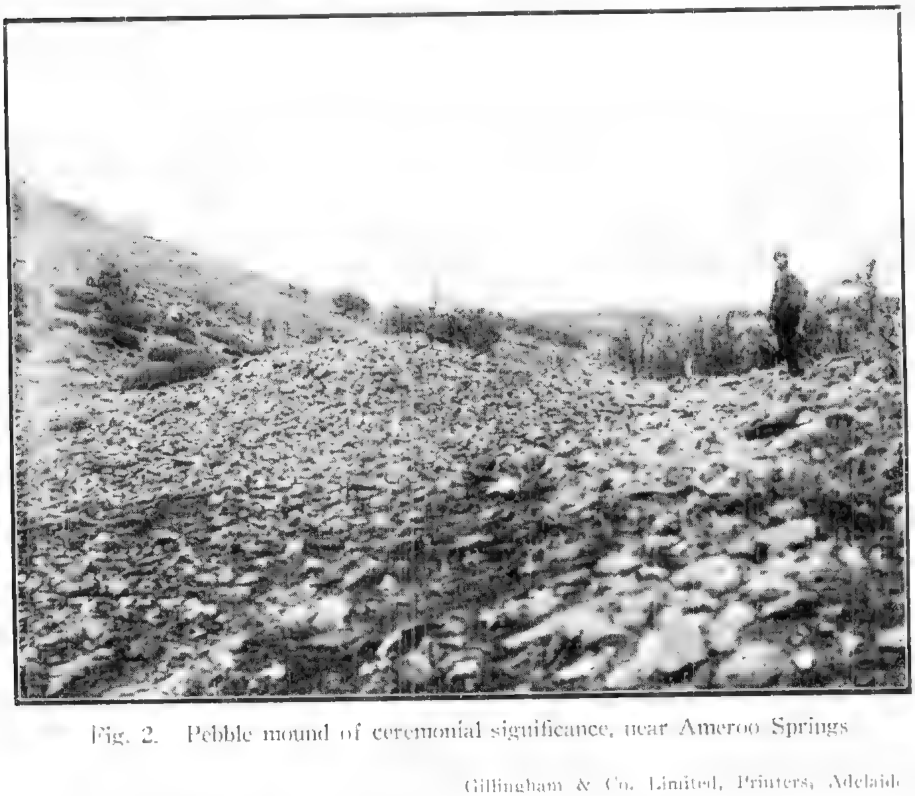

Fig. 2. Pebble mound of ceremonial significance, near Ameroo Springs

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ADDITIONS TO THE SOUTH AUSTRALIAN MINERAL RECORD.

By Douglas Mawson, Kt., D.Sc., F.R.S.

[Read May 13, 1926.]

Reference is here made to certain important occurrences of minerals which have come under my notice during recent field geological work. In several cases the importance is not as much due to their appearance in quantity or in striking form, as to the fact that the record is the first for such mineral in the State.

Andalusite: Outalpa Hills, north of Olary.

A particularly interesting occurrence of this mineral is to be met with in a locality about 2 miles due west of the Perryhumuck Well, which latter is some 12 miles due north-north-west of Olary, on the Bimbowrie track. It is developed in pegmatitic quartzose reefs intersecting a series of older Pre-Cambrian sedimentary rocks, which in this locality is highly metamorphosed by Pre-Cambrian granite intrusions. The pegmatitic reefs are apophyses of the granite bathylith. Where best developed, the centre of these reefs is massive quartz, whilst at the margins there is an outer selvage of coarse black mica and tourmaline. Between the two is a zone, several inches wide, of coarsely crystalline andalusite. It is of a pink colour and quite fresh. It is usually in the form of an interlaced mass of crystals, each several centimetres in length.

Chiastolite: Outalpa Hills.

In the same locality as the already-mentioned andalusite several belts of argillaceous schist carry abundant chiastolite crystals up to five centimetres in length. These weather out and are to be found loose, scattered about on the surface.

Chiastolite: Telichi.

On a low rise near the woolshed on Telichi Station, some 30 miles due north by east of Olary, very good samples of chiastolite are abundantly distributed over the surface weathered out of an underlying schist. In many of these, an internal pattern is well defined and occasional excellent representations of the cross are presented. For the most part, however, the markings are jumbled and the cross not clear. Externally they are dominantly square and sub-square in shape, thus recalling the "Howdenites" described[1] some years ago. The particular locality "Poothlaringla" mentioned in that report is only some 3 miles to the west of Telichi Head Station.

Chiastolites: Boolcoomata Station.

At the Dome Rock Copper Mine, situated 22 miles due north-west of Mingary railway station, Pre-Cambrian slate rocks are traversed by a fracture zone in which a pyritic copper lode[2] is located. Along the low rise a chain or two to the west of the lode the schistose argillaceous sedimentary rocks are shedding abundant chiastolites which were collected up to 9 cms. in length and 2·5 cms. across. Many of these exhibit, in section, a good white cross. In this locality the chiastolite crystals themselves evidence very definitely that mechanical forces operated in the beds after the formation of chiastolites. The effect has been to

(1) "Chiastolites from Bimbowrie, South Australia," by D. Mawson, B.E., D.Sc., Memoirs Roy. Soc. S. Austr., vol. ii., part 3.

(2) "Report on the Dome Rock Copper Mine," by L. J. Winton, B.E., Dept. Mines, S. Austr., Mining Rev., No. 29, p. 45.

round off the outlines, to produce fish-tail forms and to bend the arms of the cross as seen in cross section; features referred to the same cause in the case of the Mount Howden locality *(loc. cit.)*. Most of the Dome Rock chiastolites have suffered change to greasy-looking aggregates of pinite. Some show intermediate stages in the conversion; the central unaltered pink zone being surrounded by greasy white pinitic material.

Four miles to the south of the Dome Rock Mine, on the low hills facing the plain, several well-defined belts of chiastolite schists were located in which the crystals reach 5 cms. long and 2 cms. square in cross section. Such an outcrop is well seen about half a mile south-west of a large quartz blow and near-by the Old Boolcoomata Copper Mine. Here the majority of those lying weathered-out on the surface are square in cross section. A few only have rounded outlines as at Mount Howden. There is a marked tendency in the development of the figure to that of a well-defined white cross in a crystal of square outline. Cases were noted of alteration from without to coarse flakes of muscovite extending inwards perpendicular to the crystal faces. Here again, these occurrences have arisen by the metamorphic effects of a Pre-Cambrian granite intrusion into argillaceous sediments.

COLUMBITE: Binberrie Hill, 14 miles due north of Olary.

About a half mile east of the Old Boolcoomata homestead the granite slopes leading to the great granitic cupola of Binberrie Hill are greatly seamed by coarse granite pegmatites, in which quartz and pink felspar are the dominant features. This is a great crushed zone through which pegmatitic solutions have circulated. Besides quartz and felspar, occasional tufts of plumose muscovite appear. Where the formation becomes more quartzose, beryl crystals in well-defined hexagons up to 25 cms. in length have been secured. In one of these beryl crystals a fragment of columbite is embedded, indicating its prior crystallization. But it is rarely that the mineral is seen in the rock, it being best collected from the residual detrital matter lying on the surface, which is associated with fragments of ilmenite. It is scarce and would ordinarily be overlooked but for the vigilance of Mr. W. Coulston, of Bimbowrie Station, who first drew my attention to the existence, thereabouts, of a black mineral with the general characters of columbite or tantalite. As represented by material collected from this locality, it is an opaque, iron-black mineral of uneven fracture. The fragments range downwards from about the dimensions of a finger-nail, but Mr. Coulston advises that several much larger pieces were got in the first instance. A qualitative chemical examination showed it to consist almost entirely of oxides of iron, tantalium, and niobium. Beyond these constituents only manganese oxide was in sufficient quantity to give a definite reaction. Specific gravity determinations on three fragments gave the following values, respectively: 5·70, 5·83, 6·23. Although a separation of the tantalic and niobic oxides was not undertaken, the low specific gravity of the mineral determines it as columbite and not tantalite.

PLUMOSE MUSCOVITE: Boolcoomata Hills.

In the pegmatites in the vicinity of the columbite occurrence fine examples of plumose mica may be seen. In this, the small flakes of muscovite are arranged in bouquet-like form. On careful examination these aggregates are seen to be graphic intergrowths of muscovite and quartz. These plumose forms are distributed through a matrix of graphically intergrown felspar and quartz. A similar occurrence was encountered in the Barrier Ranges several miles north of Silverton.

VESUVIANITE: Boolcoomata Hills.

On the low ridge of altered sedimentary rocks at the back of the woolshed at Old Boolcoomata Station, two belts occur rich in this mineral. In places, almost

the entire rock, for a few inches in width, is solid vesuvianite of a brownish-grey colour. In the same locality there is a general development of this mineral over belts many feet in width. The development of vesuvianite is most intense adjacent to a pegmatite quartz reef which forms a central feature of one of these belts. Evidence is clear that the solutions producing the quartz reef have been active agents in developing the vesuvianite. One mile and a half to the east from here a long outcrop of carphosiderite [3] is flanked by vesuvianite rock in which blue fluorite is a feature in places. The mineral here is of a lighter brown colour than that near the woolshed.

PIEDMONTITE: Boolcoomata Hills.

Within quarter of a mile to the north of the sphene locality, just described, and adjacent to the track leading past Binberrie Hill to the Apatite Mine, is an interesting occurrence of piedmontite. The schistose sediments thereabouts are lying at a very steep angle. In several patches, each extending over a width of one or three metres, and continuing longitudinally for many metres, a notable proportion of this manganese epidote has been developed therein. Much of the rock is of an even, fine-grained nature, and of a colour of a general red tint with a suggestion of puce. This rock is so close textured that the piedmontite cannot be distinguished with the naked eye. However, in most of the outcrops there is a central coarse vein-like stringer of reef quartz and piedmontite in which single crystals over 5 cms. in length appear. This massive piedmontite has a dark reddish-brown appearance in the hand specimen. It is along such stringers evidently that the siliceous and manganiferous solutions responsible for the development of this mineral have invaded the strata.

Under the microscope the section is seen to be composed almost wholly of granular quartz showing strain features, and highly pleochroic piedmontite. The colours exhibited are very strong, being deep red, puce and yellow in the principal optical directions.

CYANITE: Radium Hill, Olary.

For some years past the occurrence of cyanite and staurolite in certain workings to the east of Radium Hill mining field has been known through collections made by the Government Geologist, Mr. L. K. Ward. Recently, during detailed examination of the lode area a strong formation of cyanite gneiss was met with several hundred yards to the south of the southern workings on the Radium Hill lode. The elongated blades are as much as 5 cms. in length and exhibit a general orientation in the direction of foliation. The character of the gneiss, as judged from a macroscopic examination only, suggests the reconstruction of a granitic rock along a shear zone. On the other hand, the cyanite and staurolite schists from the region further to the east exhibit features which indicate a meta-sedimentary origin.

CHRYSOCOLLA: Dome Rock Mine, north of Mingary.

In the more arid areas of South Australia the silicate of copper, chrysocolla, not infrequently appears in the weathered zone of copper lodes. No better example has come under my notice than is met with in the shallow workings of sections of the Dome Rock Mine copper lode, between the surface and about 30 feet. It is of a beautiful blue colour, and much of it is enhanced by being embedded in a jet-black base, the latter being pigmented by manganese oxide with some copper and cobalt oxides. One specimen of the chrysocolla recovered from the spoil head exhibits a tiny flake of native gold embedded in it.

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(3) Dept. Mines, S. Austr., Mining Rev., No. 41, p. 79.

Sphene: Giant's Head, near Illinawortina, Flinders Range.

Roughly-shaped crystals of a grey-brown colour occur embedded in an acid felspathic igneous matrix at the eastern end of the outcrop. The crystals are not numerous, but have been got as much as 7 cms. in length. When collected its general appearance suggested the mineral cyrtolite. However, Mr. R. G. Thomas has analysed it qualitatively and found it to be a calcium titano-silicate. The igneous rock with which it is associated intrudes a sedimentary series with a tillite horizon, which latter is assumed to be Sturtian in age.

Sphene: Boolcoomata Hills.

Intrusive massive quartz reefs rich in blocks of ilmenite are a feature of certain residual roof pendants in connection with the Boolcoomata granite bathylith. At a spot about 3 miles directly east-north-east of the Old Boolcoomata homestead, a large block of mixed sphene and ilmenite was found in such a reef. This is exceptional, as these pegmatites are normally free from sphene. Furthermore, about 20 yards away to the south, an inconspicuous and irregular stringer extending parallel to the large quartz-ilmenite formation, was located consisting largely of a clove-brown coloured sphene. The width of this stringer is variable, but not exceeding about 30 cms. It is partly quartz and partly sphene, the whole width in places being composed of the latter. A little ilmenite is met with at intervals along the length. Some of the sphene collected represents portions of single crystals at least as much as 15 cms. in length.

Albite: Tourmaline Hill, 8 miles east of Illinawortina.

An acid pegmatitic intrusion in this locality, consisting largely of quartz with abundant tourmaline, is also notable in containing large masses of albite felspar. It is of a snow-white to faintly greenish-white colour. On breaking across, it is seen to be a mass of parallel and sub-parallel, elongated crystal cleavage plates. A partial analysis by Mr. R. G. Thomas combined with optical measurements identifies it as a fairly pure albite.

Biotite: Ameroo Springs, Outalpa.

In the vicinity of Ameroo Springs, a series of metamorphosed sedimentary rocks is further intruded by a basic magma which is now largely epidotised. Adjacent to this basic intrusion is a pegmatitic outcrop which, at one extremity is massive biotite, composed of massed plates as much as 30 cms. in diameter. A pot hole has been sunk in it by prospectors, for traces of oxidised copper ores occur in conjunction with it.

Biotite: Hot Springs region, Flinders Range.

Coarse pegmatites in the granite and gneissic rocks to the west of the Hot Spring frequently have conspicuous biotite developed in them. Commonly the plates reach about 5 cms. in diameter and are black with a bright lustre. Some years ago the late Mr. W. B. Greenwood brought to the South Australian Museum plates of this biotite as much as about 60 cms. in diameter. A recent effort to locate this unusually coarse pegmatite was not successful, but since our effort, further information recently acquired indicates that Mr. Greenwood obtained the specimens referred to at a spot in the neighbourhood of about 4 miles north-west of the Hot Spring.

Allanite: Hot Spring Creek, Parallana.

This occurrence is in the neighbourhood of the Hot Spring which is situated two miles west of Parallana head station buildings and North Flinders Range. Following the creek, at a point a couple of miles above the Hot Spring there is met a broad belt of acid gneiss which contains abundantly distributed through it, perfectly obvious and conspicuous allanite. Nearby a gneissic pegmatite was

observed to carry several pieces of what appeared to be the same mineral, allanite, as large as the thumb-nail.

The gneissic rock has a streaked appearance and represents a moderately crushed rock of syenitic to granitic composition. Besides felspar and quartz the rock is seen in microscopic sections to contain a small quantity of bluish-green hornblende, allanite, notable amounts of sphene, a little zircon and black grains of iron ore, either magnetite or ilmenite. In the hand specimen the allanite is of a deep chocolate-brown to black colour; but where weathered, at the surface, it may present a bleached border zone. It is of a pitchy to resinous lustre and shows no cleavage. The individuals are somewhat flattened and reach a centimetre in length. In microscope slide it shows as a mineral of high double refraction and refractive index, and with a marked pleochroism in brownish-grey to greenish-grey tones. The smaller particles and the border zone of the larger individuals are somewhat changed, exhibiting in the slide a bright yellow colour. In some cases zoned colour bands were observed following the outlines of the mineral. A chemical test made on a fragment of the mineral resulted in a copious precipitate of rare-earth oxalates.

What is known as the Four-Mile Creek enters the range several miles to the north of the Hot Spring, and crosses a very similar allanite gneiss to that to which reference has just been made. The occurrence is at a point between one-quarter and a half-mile in from the scarp of the range. Evidently a belt of this rock extends in this locality for some miles in a general north and south direction.

HYALITE: Mount Painter Radium Field.

From the slopes of Mount Gee, which is adjacent to Mount Painter, several specimens of typical hyalite were collected. Mount Gee itself is a belt of crushed granitic and other rock which has been firmly cemented and, in part, metasomatically replaced by silica chiefly in the nature of quartz but occasionally in chalcedonic forms. Drusy vughs are abundant. Rarely, hyaline quartz is to be found coating the interior of cavities.

SAGENITE: Willouran Range.

In the bank of a creek bed a quarter of a mile north-north-west of Breaden's Hill Mine, in the Willouran Range, which locality is 8 miles west of Mundowdna railway siding, a mass several feet in length, of sagenitic quartz was noted *in situ* amongst Pre-Cambrian calcareous slate rocks, adjacent to a basic doleritic intrusion. The long needles, which are distinctly seen to reach fully 2 inches in length are, however, not rutile as is normal in sagenite, but are elongated hexagons of apatite. These are set at random in the mass of transparent, somewhat smoky, quartz.

VOLBORTHITE: Breaden's Hill Copper Mine, 8 miles west of Mundowdna.

The copper deposit is in fractured calcareous and dolomitic sediments which are fairly certainly of Proterozoic age. Some iron and copper sulphides are showing in the shallow workings, but the bulk of the ore consists of oxidised lode matter, principally red oxide of copper. The ore has been introduced as fracture fillings and metasomatic replacements.

From the surface to a depth of 6 or 8 feet there appear coatings and stains of a yellow earthy mineral which on chemical examination is found to be a vanadate of copper and calcium.

Another line of lode several hundred yards to the south, south-west of the main workings, shows in places bluish vanadiferous stains in the weathered zone. Volborthite has been recorded by the Mines Department at two locations in the adjacent Flinder's Range. In each case it is in the weathered outcrop of copper lodes.

There appears to be a definite tendency for vanadium to be stabilised as a vanadate of copper and calcium in the surface strata under the arid climatic conditions prevailing in that region. In this connection, it is interesting to further record that certain yellow-stained patches in the outcrop of the lode of the Dome Rock Copper Mine, in the arid region north of Mingary, were also found to be notably vanadiferous. Another vanadate stable under the climatic conditions of the arid north is carnotite, the uranium potassium vanadate appearing in the weathered portion of the Radium Hill lode and detected in traces at several other localities in northern South Australia.

AVENTURINE: Eyre Peninsula.

A water-worn boulder, several inches in diameter, of an interesting reddish-brown colour, was collected from amongst detrital material in the hills about 8 miles to the west of Tumby Bay. The rocks *in situ* thereabouts are Pre-Cambrian sediments invaded by acid intrusions. When cut and polished the specimen proved to be aventurine quartz, the quartz being loaded with reddish-brown micaceous flakes.

ARAGONITE: Brighton Cement Company's Quarry, Field River, Reynella.

During quarrying operations, a series of caves and passages in the limestone were, a short time ago, unexpectedly revealed. Though the passages are largely choked with residual cave earth and blocks fallen from the roof, one is able to scramble through a succession of chambers for what appeared to be a length of at least over 100 yards. No opening to the original surface exists. They represent old solutions chambers through which, perhaps, some part or the whole of the water of the Field River passed at some time in the past, when the valley floor was 50 or 60 feet higher than it is to-day. Some of the chambers, which are several yards in length and width, have a fine white crystalline encrustation on the walls. The acicular character of some of these encrustations suggested aragonite. The application of Meigen's test proved this to be the case. The occurrence is worthy of note as the circumstances of the case are rather unusual for aragonite.

SILLIMANITE: Torrens Gorge.

In the case of a number of rock specimens collected along the Torrens Gorge for a short distance, at about a half-mile to one mile above the junction of Kangaroo Creek, sillimanite is noted to be present in several. It is best illustrated in a fragment from a large boulder in the creek. The rock illustrated in this latter case is a uniformly-coloured, dark-grey, crystalline schist composed of quartz grains showing strain features; deeply-coloured biotite in small flakes; garnet of a faint pink tint; sillimanite in pearl-grey prisms; granules of black iron ore and much interstitial, minutely crystalline, sericitic mica. The occurrence of sillimanite in this locality is worthy of note, as it has not previously been known in the vicinity of Adelaide.

LEUCOXENE: Houghton.

The coarse pegmatite of the Houghton magma described by Benson,[4] and named "Yatalite," is to be met with in the quarry near the cemetery. In some cases the yatalite is altered by weathering or other agency so that although the epidote, felspar, and amphibole remain fresh the ilmenite has been converted wholly to leucoxene. As the ilmenite has been present in large individuals, the occurrence yields splendid examples of leucoxene in patches up to 5 cms. in length. It is of a dull appearance and ochreous-yellow colour.

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[4] "Petrographical Notes on Certain Pre-Cambrian Rocks of the Mount Lofty Ranges, with special reference to the Geology of the Houghton District," by W. N. Benson, B.Sc., Trans. Roy. Soc. S. Austr., vol xxxiii., p. 101.

ORGANIC REMAINS FROM BELOW THE ARCHAEOCYATHINAE LIMESTONE AT MYPONGA JETTY, SOUTH AUSTRALIA.

By C. T. Madigan, M.A., B.Sc.

[Read May 13, 1926.]

Plates IV. to VI.

In a former paper by the author (1), attention was drawn to some remarkably prolific organic markings discovered in beds below the Archaeocyathinae limestone at Myponga Jetty. These beds have since been more closely studied, with the results embodied in the present paper.

A photograph of the locality appears as fig. 2, pl. xvi., in the above-named paper, and a map of the Fleurieu Peninsula as pl. xx., showing the major rock formations.

A closer examination of the limestone on the hillside to the west of the jetty disclosed Archaeocyathinae lower down than previously noted. The junction of the Archaeocyathinae-bearing bed with the underlying "mottled" limestone is seen in a shallow depression on the flank of the hill, and another 150 feet is added to the thickness of the Archaeocyathinae limestone at this point, bringing it up to 700 feet. A careful measurement of the thickness of the Archaeocyathinae beds in a steep gully entering the sea, a half-mile west of the jetty, gave 707 feet. From the headland on the west side of the jetty the coast runs W. 28° S. in a straight line for half a mile along the strike of the rocks, with cliffs 150 feet high above a narrow rocky shoreline. The strike, N. 59° E., and dip 47° S.E., are constant in the neighbourhood. The Archaeocyathinae beds begin a short distance inland from the cliffs, which are themselves of the underlying "mottled" limestone, slate, and arenaceous limestone. These underlying beds are exposed to a thickness of 427 feet at the headland, and 283 feet at the gully half a mile west, passing under the sea in each case. These beds correspond to the 1,800 feet of dark slates below the Archaeocyathinae limestone at Sellick's Hill, where they contain the phosphatic nodules, referred to in the above-mentioned paper (1), in their higher zones, but at Myponga Jetty the beds are more varied in character, with arenaceous and flaggy facies.

Conulariida.

The "mottled" limestone, with characteristic serrated weathering, occurs immediately below the Archaeocyathinae beds, as described by Sir Douglas Mawson (2) at Sellick's Hill, but the mottled effect extends to a much greater depth at Myponga Jetty, occurring at intervals among arenaceous and flaggy limestones and calcareous shale down to a depth of 340 feet below. At this horizon occurs a ferruginous band up to 4 inches wide, which is first seen at the headland at water level, and may be traced along the bottom edge of the cliffs for half a mile to the westward. It can be recognised by the dark red surface of the upturned slabs of rock, the bed itself being a natural parting plane. These rock surfaces are covered with the remains of "pteropods," and it is from this horizon that the specimen first found by Miss M. U. Pitt (1) must have come. The fossils are crowded together in places, sometimes lying in contact. They are of black limestone completely soluble in hydrochloric acid, and show out strongly against the grey or yellowish matrix. The bed itself is of "mottled" limestone, consisting of small dark-blue lenticular masses of limestone, half an inch thick by,

usually, 1 inch to 3 inches in length and width, though often several of the masses join up into quite large slabs of limestone, embedded in a yellowish calcareous silt. The silt is in places crowded with the fossils, but the limestone masses when broken across are also seen to contain them, though more sparingly. This militates against the limestone masses being considered solely due to algal growths.

The fossils are of average length, 0·3 inch, some were 0·4 inch, and two reached 0·7 inch. The ratio of length to greatest diameter is 7 to 1. They are very slender, tapering, conical tubes, acutely terminated posteriorly, with circular section, smooth and straight. Many specimens show a cone-in-cone structure, as many as four cones being distinguishable in one example. There are no signs of surface ornamentation, and no opercula were seen.

They correspond closely with the genus *Salterella* (Billings), from the Lower Cambrian of North America, and may with that genus be placed in the family Torellellidae, of the suborder Conulariida (Miller and Gurley) of the Gastropoda, rather than among the Pteropoda. No other fossil remains were found among the Conulariids.

In the cliff face immediately above the Conulariid bed there is seen a huge-scale variation of the "mottled" limestone, pl. iv., fig. 1. Here the limestone masses are up to 10 feet in diameter, and are seen as the dark areas in the yellowish calcareous slate. The limestone contains a certain amount of carbonaceous matter. The bedding planes cross indifferently the black limestone and yellow slate, as may be seen in the photograph.

Annelid Trails.

Below the Conulariid zone, the beds become much more arenaceous and flaggy. This phase continues out under the sea, and has a visible thickness of 87 feet. These beds are shown in pl. iv., fig. 2, a view looking eastwards along the strike. The surfaces of the slabs are, in places, covered with intricate markings, standing out in remarkable relief. These markings are found through a thickness of 63 feet below the Conulariid zone, fading out in the neighbourhood of the water's edge. They are visible on all weathered surfaces in the zone, to a greater or less extent, but on some slabs they are specially well shown. These slabs are often as large as a table top. One piece, measuring 6 feet 6 inches by 1 foot 4 inches by 1½ inches thick was brought in, and pl. v. shows portion of the surface of this slab, one-half natural size, and pl. vi. a section of the side of the slab, full size. Pl. v. is typical of the appearance of the surface of the slabs, which is seen to be made up of short interlaced tubes of varying sizes, straight or slightly curved, without any apparent system or orientation, and scattered flattened nodules which seem to be distinct from the tubes. The tubes are unbranched and never enter one another, but pass under and over. Owing to their interlaced nature, the tubes cannot be traced for any great distance; 4 inches is the greatest length and 2 inches the commonest for the larger tubes, as far as can be ascertained. The tubes are all somewhat flattened. Their greatest diameter is ·27 inches (7 mm.), and there are all sizes down to ·04 inch (1 mm.). The flattened nodules show a maximum dimension of ·8 inches, the commonest width across being about a half-inch. The tubes do not radiate from or appear to bear any definite relation to the nodules.

Pl. vi., a photograph of the side of a slab with portion of the surface, shows that the markings are in layers, and are in the nature of surface deposits, not penetrating the beds.

The general petrological nature of the slabs is arenaceous limestone. The tube-like markings themselves are specially arenaceous in appearance, the sand grains standing out on their somewhat pitted surfaces. The whole surface is

yellowish-brown in colour. The tubes have been surrounded by and embedded in less arenaceous limestone of a bluer colour, and occasional small areas of light-blue limestone are scattered over the surface, one being visible near the top of pl. v. The tubes have been covered by a thin layer of black carbonaceous limestone, which has weathered off the surfaces, but is seen at the sides, scaling off.

Though pl. v. is typical of the great majority of the markings, some special types were noted where they were less crowded. The most notable of these is shown in pl. iv., fig. 3, which is a little larger than half-size. The general nature of each short tube-like mark is still the same, but they show an obvious arrangement, branching alternately left and right of the main direction of the trail. A very distinct large track of the same nature was noted on one slab. It was 2 feet 6 inches long, and was in the form of a gentle curve. The individual marks averaged 1 inch long by a quarter-inch wide.

Several microscope slides were made of the rock, including horizontal and vertical sections from the slab, a section of a nodule, and longitudinal and cross sections of the tubes. The structure of the rock is fine granular, with clear angular quartzes forming about 50 per cent. and calcite 50 per cent. There are also scattered muscovite and biotite, and a very few crystals of twinned plagioclase, and throughout a brown staining of carbonaceous matter, with, in places, little clusters and rows of opaque-black specks only distinguishable under high power. These appear to be carbonaceous matter, probably graphite.

The sections of the rock show dark flowing lines and areas and lighter areas. The darker areas represent the calcareous mud and the lighter areas the tubes, which show up as ridges on the slabs. The light areas are coarser grained, with larger and more numerous quartzes. The darker areas contain more calcite, are finer grained, and contain most of the biotite and little grains of carbonaceous matter. The carbonaceous matter is specially concentrated as a border round the lighter areas.

No special features could be observed in the sections of the nodules. They are merely granular aggregates of quartz and calcite. The longitudinal and cross sections of a tube from the surface showed the interior to be coarser and richer in quartz, with a narrow, dark, and very carbonaceous border.

A sample of the rock was analysed for phosphate by the author, and showed 0·7 per cent. P_2O_5, rather a low figure for a limestone, and of no special significance. After dissolving the original sample in concentrated nitric and hydrofluoric acids, there was a considerable black residue of carbonaceous matter, which was destroyed on ignition.

Conclusions.

The conclusion finally arrived at is that these remarkably well-preserved and abundant markings are mainly the castings and borings of annelids. This was the author's first impression, but a hope arose subsequently that they might be algal remains, a hope that must be abandoned in the light of further study. Dr. Charles D. Walcott, the great authority on Cambrian fauna, kindly wrote, "Judging from the photographs, the surface of the slab is covered with casts of large and small annelid trails and borings," an opinion he has not altered on receiving a specimen.

As the tubes never appear to enter, but only to lie across one another, and also all appear to have been horizontal, there is no evidence of burrows penetrating the mud, and little of trails. Most of the markings are borings deposited on the surface, sometimes in the form of pellets, but more often in cylindrical shape.

The type of marking shown in pl. iv., fig. 3, is more like a trail, possibly that of a crustacean.

Literature.

Worm trails and markings are known in rocks of all ages from the Algonkian (Belt Series of Montana, Walcott) to the present. These markings are very common in the Potsdam sandstone of the United States and Canada, of Upper Cambrian age, and various names were assigned to different types of markings before their true nature was understood, names which there seems little value in retaining.

Various writers have ascribed the markings to tracks of molluscs, or of crustaceans, or to remains of fucoids or of algae. Dr. C. D. Walcott (3) ascribes Protichnites (Owen) with finality to trails of trilobites. These are quite unlike any of the Myponga Jetty markings. In the same paper Climactichnites (Logan) is referred to annelid trails. These latter are up to several inches in width, and again cannot be compared with the Myponga fossils.

A remarkable occurrence of the remains of annelids themselves from the Burgess shale, of Middle Cambrian age, from near Field, British Columbia, has been described by Dr. Walcott (4).

It is unfortunate that, generally, where the trails and borings are best preserved, the remains of the annelids themselves are absent. The trails are usually in arenaceous beds, which are unsuitable for the preservation of organic remains.

Markings of doubtful origin are fully dealt with in a paper by Sir J. William Dawson (5), and the Myponga Jetty specimens are closely comparable with *Scolithus* (Haldimand), as depicted in that paper. Fig. 7, p. 603, "Slab with castings of *Scolithus*, Perth, Ontario," a specimen from the Potsdam sandstone, bears a strong resemblance to the Myponga slabs. The markings are described as rounded pellets and ridges of hardened sand. In the Myponga specimens there is no evidence of tubes descending downwards, as illustrated in fig. 8 of the same publication.

Scolithus linearis (Hall) and *S. canadensis* (Billings) are considered by Sir J. W. Dawson to be of similar origin to the specimen illustrated by fig. 7, that is, worm burrows and castings.

Fig. 15, from a specimen of the Potsdam sandstone of St. Anne's, Island of Montreal, entitled "Worm burrows seen in section, owing to manner of preservation and weathering," shows cylindrical forms in a network, very similar to the Myponga slabs. *Planolites* (Nicholson) and *Arenicolites* (Salter) are referred to this specimen, which is said to differ from *Scolithus* only in their more tortuous character and in their being casts of trails on the surfaces of beds rather than burrows or tubes penetrating them.

This is the first record of worm burrows, or of any animal remains other than obscure traces of radiolarians (7), from below the Archaeocyathinae limestone in the Cambrian of South Australia. Professor W. Howchin (6) has recorded burrow holes, casts, and tracks of annelids in the Eastern Flinders Range, near Wirrialpa, in a thin impure limestone in the *Obolella* and *Girvenella* horizon, above the Archaeocyathinae. Trilobite remains are abundant in that zone.

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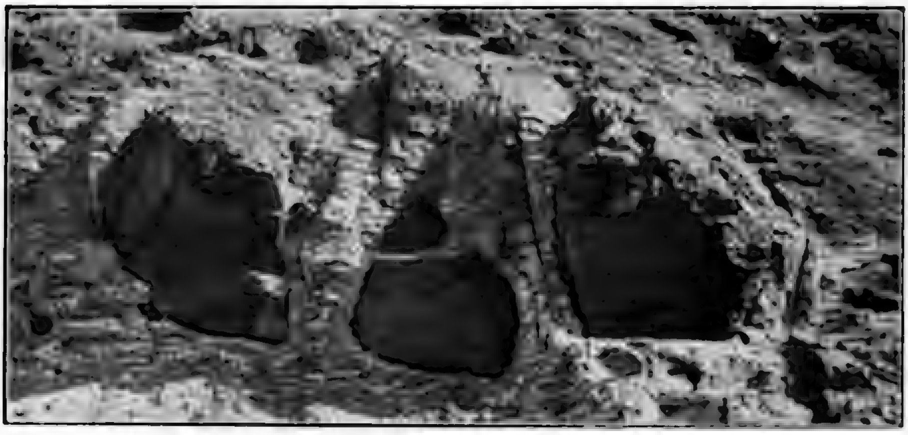

Fig. 1

Fig. 2

Fig. 3

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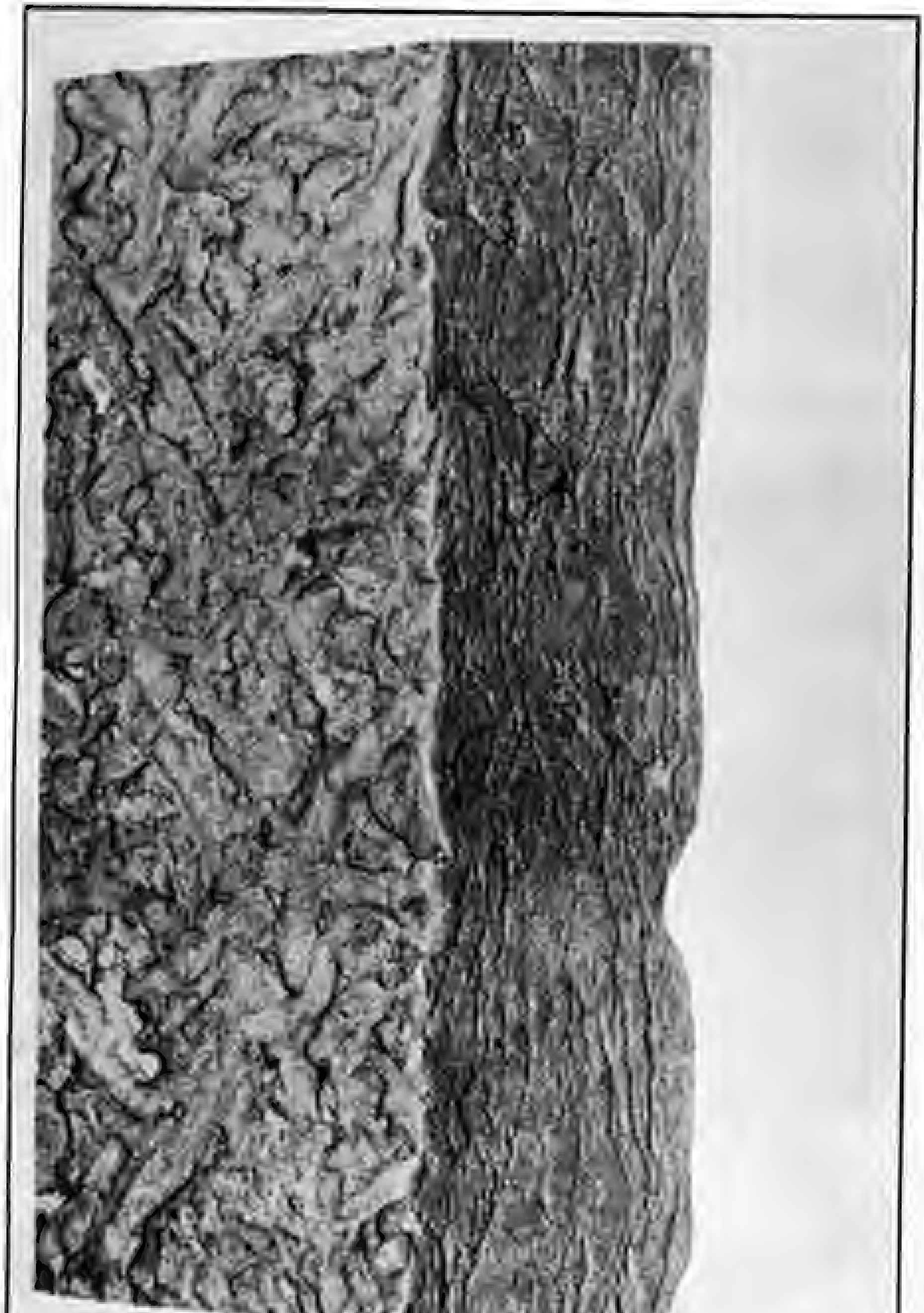

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DESCRIPTION OF PLATES IV. to VI.

Plate IV.

Fig. 1. Masses of dark limestone in yellow slate, a large-scale variation of the "mottled" limestone, Myponga Jetty.

Fig. 2. Looking north-east along the strike of the arenaceous limestone beds containing the annelid castings, Myponga Jetty, below the cliff shown in fig. 1.

Fig. 3. A rarer class of trail in the arenaceous limestone slabs, Myponga Jetty. One-half natural size.

Plate V.

Portion of the surface of a slab from the arenaceous limestone at Myponga Jetty, showing the annelid trails and castings. One-half natural size.

Plate VI.

The side and portion of the surface of part of the same slab as shown in pl. v., showing the stratified nature of the markings in the side or sectional view, which is the left-hand darker portion of the photograph. The line down the picture separating the darker and lighter portions is the edge where the side meets the surface of the slab. Natural size.

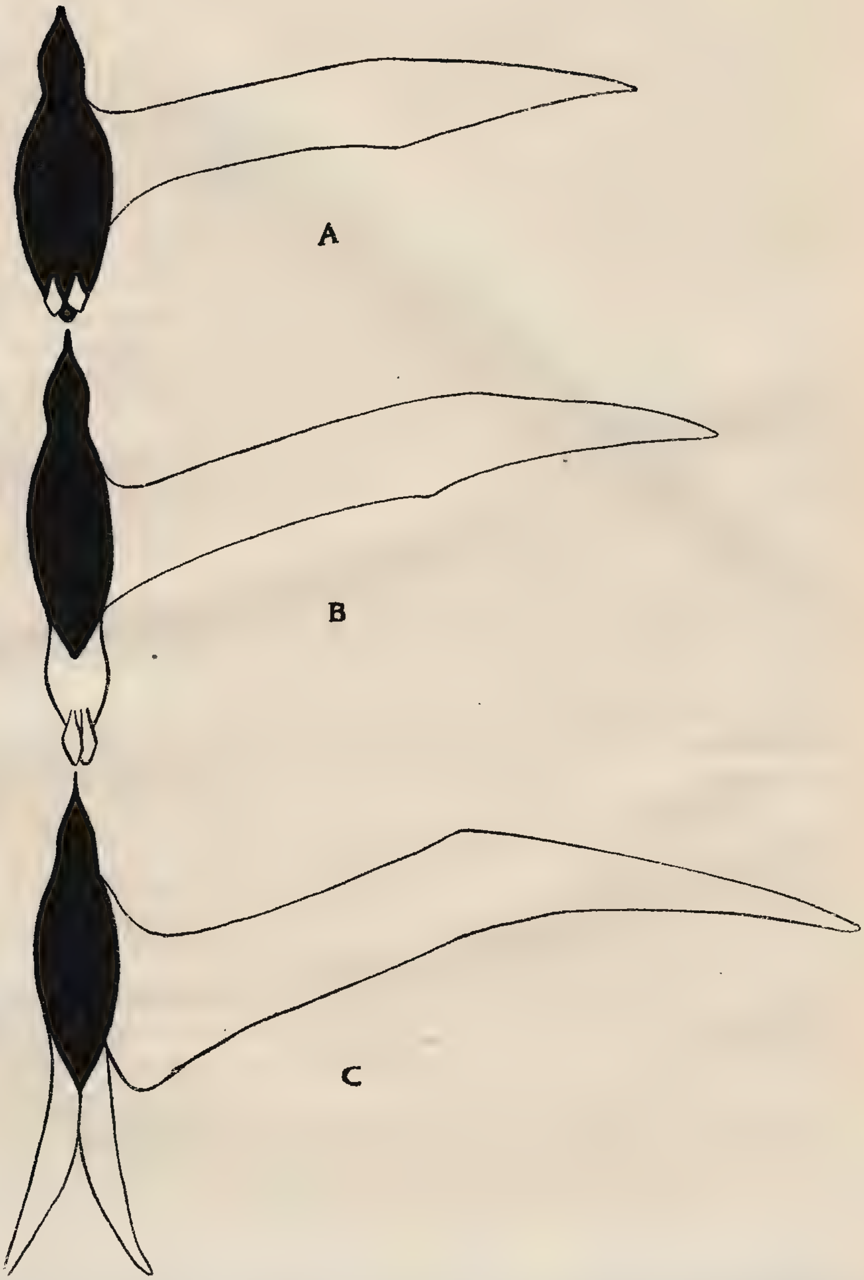
SOME OBSERVATIONS ON THE FLIGHT OF SEA-BIRDS.

By Frederic Wood Jones, D.Sc., F.Z.S., F.R.S.,
Professor of Anatomy in the University of Adelaide.

[Read June 10, 1926.]

It has probably struck every observant ocean traveller that there is a well-marked distribution of those more or less thorough-going pelagic birds that are encountered upon any protracted sea trip. This sharpness of the definition of distribution is far more pronounced when we travel from Pole to Pole than when the voyage is made more or less along one of the parallels of latitude. It must be a very remarkable experience for anyone to note the birds encountered on an ocean trip from, say, 40° S. latitude to 50° N. latitude. A repetition of the voyage only serves to make the wonder the greater, for there is thrust upon the observer two very obvious facts: (1) that there is a very definite zoning of distribution which is normally but little transgressed, and (2) that there is a repetition of general morphological type at latitudes roughly equidistant north and south of the Equator. If we make such a journey from south to north we first encounter, as the most conspicuous of the pelagic birds, the giant Albatross, and, by a succession of smaller species and the Mollyhawks or Mollymawks of sailors, the passage is made to the larger Gulls; these in their turn drop out and smaller Gulls are encountered until the Equator is passed. Having passed the Equator small Gulls are again encountered, then larger Gulls, and finally Razor-bills, Guillemots, Puffins, and Awks. This is only a very rough summary of the types observed on an individual journey. The first question that must naturally arise is: Why do the Albatrosses desert a ship sailing northwards from southern latitudes? During my service on a cable ship, more than twenty years ago, I watched these birds for days on end. They would follow the ship when she steamed about, or sit on the water around her when she was on cable ground. They would glide all day regardless of the speed of the vessel, and, so far as I could learn, regardless of the direction of the wind; moreover, they would do this without altering their elevation or without, as far as one could see on close observation, moving any part of their wings. Save for the projection of their otherwise closely adpressed feet, when they wished to drop to the water to pick up food, their flight appeared to be merely an ability to slide ahead with no other power than their own weight and a presumably instantaneous ability to automatically readjust their planes and alter their cant and poise—largely by movements of the head.

As an Albatross is watched gliding ahead over the deck of a ship steaming fifteen knots, it seems as though the whole bird were rigid; save its head and eyes. It passes ahead and cants its whole body and wings, seemingly without any wing movement, but with a definite, and apparently purposeful, alteration of its head poise, and passes astern in a wide semi-circle high in the air. Almost gliding to sea level astern it comes round in another wide semi-circle—again without apparent wing movement—and overtakes the ship, gliding level above its decks, only to repeat the manoeuvre. In all this there is no flap of the wings—no visible wing movement. To one unskilled in aeronautics it seems as though the bird were a completely satisfactory and vitally adjusted plane, which dictated its planing activities largely by body poise, in which head and neck, rather than wing movements, played the greater part. But it is a thing anyone who has travelled northwards from the "roaring forties" must have noted that,



A

B

C

Diagrams to show the proportion of body to plane area of—A: a Southern Albatross *(Diomedia exulans)*. B: a Northern Albatross *(D. nigripes)*. C: a Man-o'-War Bird *(Fregetta aquilla)*. The body length of each diagram is reduced to the same scale.

though when in southern latitudes the Albatross seems to be so completely adapted and so entirely master of its element, it appears to lose its mastery as progress is made northward. One day on a northward journey there will be a dozen Albatrosses planing astern of the ship in perfect mastery of the air, the next there will be fewer, the next morning there will be, maybe, two, or a solitary individual making rather laboured flight. At about the latitude 34° S., before Fremantle is reached, the solitary individual is left flapping behind.

Now it must occur to anyone to ask: Why does the last Albatross desert in this latitude? Why does a straggler, or so, hold on and fly in a laboured fashion and then fall astern? In the first place, it is obviously not because its food supply is lacking. Even if the bird is only depending on the ship as a source of food, it is just as prolific north as it was south of that latitude. Nor can it be the loss of its habitual pelagic food, for, so far as one can see, it has as good a diet from ocean flotsam on the Equator as it has at 40° S. Again, it cannot be that it is getting unduly far from home. Already it is probably thousands of miles from what may be considered its home, and, within the limits of its southern latitude, distance seems to be no object. It seems as though it were merely the travel northwards that was prohibited: there appears to be some factor which forbids it to enter Equatorial regions.

There appears to be a perfect mastery of aerial conditions in the south, a lessening mastery further north, and a positive disability when the journey is made towards the Equator. The last solitary flapping representative seems to tell the story of an inability to adjust flying conditions to an Equatorial environment.

The same facts hold true with regard to the northern representatives *(Diomedia nigripes, D. albatrus,* and *Talassogeron culminatus)* of the Albatross, for these birds will follow a ship sailing southwards in the Pacific in the same way that the southern Albatrosses follow from the south in the northward journey. But there is this difference, that the northern representatives range nearer to the Equator. These birds roam along the western coast of North America, and great colonies have their nesting sites on Laysan Island, in latitude 25·40° N. Some species, it is said, notably *D. nigripes,* even range as far south as the Tropic of Cancer, and one *(D. irrorata)* even resorts to the Galapagos Islands for its breeding grounds.

Just as the Pacific Gull of the south *(Gabianus pacificus)* affords a most remarkable parallel to the greater Black-backed Gull (*Larus marinus)* of the north; so does the northern Sooty Albatross *(D. nigripes)* show the most striking general similarity to the southern *Phoebetria fuliginosa.*

Here, however, there is a remarkable distinction, for whereas in the southern Albatrosses the tail is almost absent, in the northern members (especially in *D. nigripes)* it is of considerable length, and, moreover, this bird carries its feet projecting behind the tip of its tail.

In my observations upon the gliding birds that may be observed from the deck of a steamer, I have been unable to confirm a great many statements that have been made from time to time concerning the method and conditions of flight. In particular I have been quite unable to detect certain "wing adjustments" mentioned by Dr. Hankin (On observations of transiently visible movements, "Aeronaut. Journ.," July-Sept., 1915, vol. xix., No. 75, p. 104), and this inability, as I have previously stated, extends to the recognition of the "wing flapping" he has recorded in connection with what I have termed the planing of flying fish. Dr. Hankin has made an effective plea that this power of observing such movements is a matter of highly trained practice; and it is, therefore, easy to assume that other observers have not had sufficient practice or do not possess sufficiently acute vision. Be that as it may, it can hardly be due to any lack of

training or acuity of vision, that I have been quite unable to detect any evidence of the presence of the "soarable air," possessing some special physical quality, which Dr. Hankin has discerned as existing in the wake of a ship. Of this "soarable air" he says (On the Flight of Sea Gulls, "Aeronaut. Journ.," Supra, p. 84): "With rare exceptions, Gulls are only able to soar near sea level in a curiously restricted area on the leeward side of the stern of a steamer. The passage of the steamer has caused some change in the air in virtue of which air otherwise appearing as "unsoarable" now behaves as "soarable air."

I quite agree with Lilienthal ("Zeitschrifé fur Flugtechnik und Motorluftschiffahrt," June, 1914, p. 196) that observations made at sea do not tend to confirm the existence of any specially "soarable" area in the neighbourhood of the wake of a ship, and the fact that sea birds glide about in the wake is merely evidence that they are following a ship in search of food. Indeed, when Dr. Hankin cites as a demonstration of the existence of this "soarable area" the fact that a Gull gliding around the flagstaff of a moving ship, perched on the staff when the ship slowed down, and glided off again when she gathered way, he seems to me to draw an entirely unwarranted inference from his simple observation. In this behaviour of the Gull I see no more evidence of the existence of any specially "soarable area" in the wake of a ship than could be inferred for the existence of a "walkable" area behind a cart because the carter's dog sat down in the road when the vehicle stopped.

From experience gained in a cable ship when lying on cable ground and watching Albatrosses gliding over the sea in all directions without special relation to the stationary vessel, I am forced to agree with Lilienthal in his objection to Hankin's conception of a special "soarable area" in the lee of a moving ship. I am far from denying that birds may take advantage of eddies caused by the wind striking any impediment, but I think that if Hankin's thesis were to be accepted, and the explanation of the gliding of pelagic birds were to be looked for in the presence of specialised air currents, ascending or descending, caused by the ship, the investigation of the question as a whole would be seriously hampered.

Indeed, it may be urged that even Barstow has dismissed the question of bird flight in rather summary fashion when he says, "The smaller birds fly with ease and with a very rapid flapping of the wings; larger birds spend long periods on the wing, *but general information indicates that they are soaring birds taking advantage of up currents behind cliffs or a larger steamer*" ("Applied Aerodynamics," 1920, p. 8). To this statement it might be objected that ease of flight is not necessarily expressed by the great expenditure of muscular energy in the rapid flapping of the wings, and that to presuppose the presence of a steamer or anything else in the open wastes of the ocean as necessary to the soaring of the Albatross is manifestly incorrect.

I shall therefore regard the soaring and gliding flight of pelagic birds, as I have observed it, as a phenomenon due rather to the morphological adaptation of the bird as an adjusted plane, than to any special and chance condition of "up currents" or "soarable air" caused by impediments to the passage of air across the open ocean.

Regarded in this way, the zoned north and south distribution of the different morphological types of sea birds and the failure of the Albatross to follow the ship into the tropics, must be investigated from the point of view of the mechanics of bird structure correlated to the environment to which it appears to be adapted.

The great Southern Albatross is an extremely heavy bird, weighing as much as 12·7 kilos. (Pettigrew), and it is a bird of rather peculiar form, having wings

which, though long, are very narrow (with a long span but a short chord); moreover, it has practically no tail. It is, in fact, a bird that has a large heavy body and a small plane surface. Indeed, were an Albatross to have the same proportion of plane surface to body weight as has a Swallow, it would need wings with a span of about 40 feet and a chord of 3 feet.

It has repeatedly struck me that the desertion of a ship nearing Equatorial latitudes was accompanied by, if not indeed directly due to, a lessening mastery of the air on the part of the Albatross. It, therefore, appears to be worth inquiring if an Albatross, as a morphological avian type, possesses a ratio of body weight and plane area which makes it adapted to planing flight in what may be termed, in the language of aerodynamics, a definite standard atmosphere. In this case the standard atmosphere would be constituted by a relatively very low temperature and a pressure at about sea level.

Under such conditions the atmosphere is of its maximum density, and therefore has the greatest sustaining power for any body planing in its medium. Is it possible that an Albatross as an adjusted plane is of necessity confined, as far as its planing activities are concerned, within the limits of distribution of its peculiar standard atmosphere, which is characterised by a maximum of density and, therefore, of sustaining power? For the present we may neglect the factor of absolute or aneroid height, for we are dealing only with those pelagic birds which plane at or about sea level, and the temperature of the air need, therefore, alone be considered. With rise of temperature there is a very rapid decrease of density, and therefore a very rapid decrease in the sustaining power of the atmosphere. For a simple statement of this principle I am indebted to Professor Kerr Grant: "The density per unit volume is equal to the weight per unit volume. This varies inversely as the *absolute* temperature. Thus, the weight at 38° C. (=100° F.): the weight at 0° C. (=32° F.)::273+0°:273+38°=273:311. Thus the buoyancy at 100° F. is diminished, as compared with that at the freezing point, by approximately 4 parts in 31, or 13 per cent. The effect of the higher percentage of water vapour in warm air over the ocean will be to produce an alteration of density in the same direction as that due to temperature. If the air be saturated at both the above temperatures, the loss in buoyancy at the higher temperature may be shown to be approximately 2½ per cent." It is therefore obvious that at the Equator the buoyancy of the atmosphere may suffer a diminution of more than 15 per cent. when compared with the conditions prevailing in colder latitudes; and this diminution is, of course, a very considerable one.

In order to carry the investigation a stage further, it is necessary to have some data concerning the body weight and the plane areas of different types of birds, and, fortunately, a very great deal of information upon this subject was gathered by Col. J. D. Fullerton in the First Report of the Aeronautical Society of Great Britain in 1911. Throughout this report wing area is alone given as plane area, and thereby the plane area of the tail is omitted from the calculations. This is an important point. Supposing a bird of a definite morphological type were to be more or less restricted to its zone of standard atmosphere by the relatively small plane area of its wings in proportion to its body weight, it would be possible to increase its plane area by increasing the size of its wings. But with increased size of wings there must be increased musculature for the movement of the wings, and increased musculature entails increased body weight. The flight muscles of a bird constitute a very considerable proportion of its body weight, averaging about $\frac{1}{6}$ (Borelli): the formula $\dfrac{\text{Weight of body}}{\text{Weight of flight muscle}} = \dfrac{W}{M}$

varying from 13·88 in the Black Kite *(Milvus migrans)* to 3·21 in a Ring Dove *(Calumba palumba),* according to Winter. The data for estimating the value of this formula in the Albatross are not available, but for the Common Gull *(Larus canus)* $\frac{W}{M} = 10{\cdot}55$, according to Legal and Reichel. It is, therefore, obvious that birds cannot indefinitely enlarge their wing area and that the size of a flying bird must be limited. But though a bird cannot increase the plane area of its wings without increasing its body weight, it can add the very considerable, and adjustable, plane area of the tail, with the involvement of only a very small amount of musculature for its regulation. It would seem likely that this is one of the great purposes of the avian tail. We know that the tails of birds are adapted to many ends: they function—like the feet of the Albatross—as elevators or depressors of the flying bird; it is possible that they are used to a slight extent in lateral steering; like all parts of the plumage of a bird they may be modified as secondary sexual ornaments; but I think it might well be argued that the primary purpose for which they are developed is the provision of an extra plane which may be adjusted in its area and which does not require a great mass of musculature for its adjustment. The omission of the tail plane area in the data available is, therefore, a serious factor, and the results would be rendered far more striking were this factor included in the estimation of the plane area.

In order to arrive at some sort of formula to express the morphological form of a bird as a mechanical aeroplane, we may employ a method adopted by the Bird Construction Committee and take $\frac{\text{Weight of bird in kilos}}{\text{Area of wing planes in sq. metres}}$ or $\frac{W}{W.A}$ but it must be remembered that the full expression would be $\frac{\text{Weight of bird}}{\text{Total plane area}} = \frac{W}{P.A}$ for the presentation of which we have as yet no data. In the case of the Albatross the value of $\frac{W}{W.A}$ is practically equivalent to $\frac{W}{P.A}$ since the plane area of the tail is almost negligible, but in the case of the Gulls, and especially so with the smaller members, we must remember that the *ratio* $\frac{W}{W.A}$ is considerably larger than $\frac{W}{P.A}$.

Taking those cases for which we have sufficient data, the formula $\frac{W}{W.A}$ in various pelagic birds is shown below.

TABLE I.

Species.	$\frac{W}{W.A}$
Albatross *(Diomedia exulans)* ..	16·73, average of 3 observations
Giant Petrel *(Procellaria gigantea)*	9·6, simple observation
Herring Gull *(Larus argentatus)* ..	4·81, average of 8 observations
Common Gull *(Larus canus)* ..	4·67, average of 5 observations
Black-headed Gull *(Larus ridibundus)*	2·84, average of 3 observations

It is therefore obvious that, even neglecting the tail plane area present in the Gulls included in the list, the plane area of the Black-headed Gull is vastly larger relative to the body weight, than is the plane area of the Albatross. I do not doubt that could the data for the whole series of pelagic birds encountered in a direct line from Pole to Pole be collected, we should see a fall in the value of $\frac{W}{W.A}$ from South Pole to Equator and a rise from Equator to North Pole; the alteration being due in these birds that plane at sea level to the temperature and, therefore, the density of the air of the zones which they frequent.

It will be at once objected that there are many birds, which fly at or about sea level, that do not have a very remarkably restricted geographical range, even when that range is considered in the terms of temperature zones.

The answer to this criticism is that, although a bird may have, relatively to its weight, too small a plane area to sustain itself in gliding or soaring flight in a warm, and therefore less dense, atmosphere, a bird with a relatively large plane area will be able to use both warm and cold atmospheres at or near sea level. It is the small-planed, heavy bird that will show limitations of distribution. It must be remembered that the analogies between a bird in soaring or gliding flight and an aeroplane cannot be carried to extremes. In an aeroplane the ratio of body weight to plane area is fixed—it cannot increase its plane area when it encounters a less dense atmosphere, caused either by altitude or temperature; but it can increase its "lift," and so compensate for the loss of density, by increasing its speed by virtue of the added revolutions of its air screw. A bird cannot do this. If adjusted as a plane to a dense standard atmosphere it must cease to act as a plane and resort to laborious flapping in a rare atmosphere; or if it be a bird which possesses a sufficient tail it can increase its plane area by spreading its tail. For the practically tailless birds like the Albatross of the south or the Puffins, Razorbills, Guillemots, and Awks of the north, it is easy to see how their inadequate plane area and their relatively large heavy bodies have dictated a restricted range in southerly or northerly regions of cold air.

The question of size in birds, when it is thus considered merely as a part of a necessary relation between body weight and plane area, becomes a very interesting one. A rapacious bird must necessarily be a bird of some size in order to overcome the smaller kinds, and it is fortunate that among the class of pelagic gliders there has been developed a group of rapacious birds of very considerable size and of very wide tropical range. In the Frigate or Man-o'-War Birds *(Fregetta)* we have birds large enough to overcome the smaller pelagic birds that live in the presumably rarer air of the Equatorial zone, and which, moreover, need to soar at considerable altitudes. Unfortunately, I have been unable to obtain any data concerning the weight and plane areas of the Frigate Birds; but I have been compensated in this by the opportunity of seeing the very instructive exhibition of flying birds in the Bird Hall of the New York Museum of Natural History. In this hall there are exhibited, suspended from the lofty ceiling, various birds with their wings extended in the natural position of flight. No more instructive exhibit could be made to demonstrate the small, light body and vast wing and tail plane areas of the Frigate Birds of the warm tropical airs and the large heavy body and restricted wing, and absent tail plane areas of the Albatross of the cold southern seas.

Again, other things being equal, a bird that habitually conducts its planing operations at great altitudes will need a larger plane area than one that is fitted to plane at sea level, and the contrast of a Condor with an Albatross is instructive

in this respect. A Condor *(Sarcorhampus grypus)* of the same weight as an Albatross has, according to the data given by Loughreed, a wing area twice as large, and an additional tail plane area into the bargain.

So far, only those birds that carry out most of the evolutions of flight by planing, soaring, or gliding have been considered, and it is not proposed to carry the inquiry into the more complicated questions of the adjustment of those birds which progress by varied forms of wing flapping.

Nevertheless, there is sufficient data to indicate that what might be termed a general utility bird, which progressed by some method of flapping, has the $\frac{W}{W.A}$ ratio in the region of 4, and the additional benefit of an adjustable tail: such a combination is seen in the common Sparrow. Again, several very interesting problems arise in connection with members of avian families which inhabit extremely different temperature zones. In the Northern Whooper Swan the $\frac{W}{W.A}$ ratio is as high as 21·3, and here it is very evident that an instructive comparison could be made with the Black Swan of Australia; but, unfortunately, no data are available for this bird. In the northern Ducks, again, the ratio is high, averaging about 12, and it is possible that in the Ducks of the warmer parts of the world some diminution of this ratio might be found.

These and other problems of avian structure must, however, await future investigation, since at the present time there are no data upon which conclusions could be justly based.

There is, however, one very remarkable phenomenon that cannot be dismissed in this way. We have seen that in passing from the Equator towards either Pole very much the same series of avian types is encountered as successive zones of temperature are traversed. One of the most astonishing features of this north and south parallelism is the extraordinary similarity of certain Gulls of comparable northern and southern latitudes, and of the most striking pairs of parallels I would instance the Great Black-backed Gull *(Larus marinus)* of Northern Europe and the southern Great Black-backed Gull or Pacific Gull *(Gabianus pacificus)* of the Australian coasts. There is surely food for reflection in the development of these two similar species, representatives of different genera in similar habitats. Both *Larus marinus* and *Gabianus pacificus* are on the road to what may be termed the heavy-bodied polar birds, but both have ample wing plane area. Towards the Poles, in the dense colder air, the wing plane area relative to the body weight diminishes, the birds still being efficient gliders in their standard atmospheres with considerably reduced planes. The large-bodied birds have relatively smaller wings, and the curious fact is that this tendency for wing area to decrease relatively to body weight culminates at both Poles in the production of flightless birds—the southern Penguins and their extraordinary parallels, the northern Awks.

At the present time it does not seem possible to go beyond mere speculation in this matter; but it would appear, at first sight, to be a remarkable train of events that could lead to a reduction of plane area owing to the increasing density of the supporting medium, and finally to such a degree of reduction as to render flight impossible. We seem to be face to face with a definite trend of morphological adaptation—the diminution of plane area relative to body weight, which

culminates in the loss of such an important and distinctive avian function as flight.

It may, indeed, be legitimate to carry these speculations beyond the limits of avian morphology and inquire if other flying creatures show any similar tendency. Do other volant creatures show the reduction of plane area and increase of body weight when the conditions of their environment include a cold dense standard atmosphere? It might be suggested that the large-winged, small-bodied butterflies, which fly in the warm sunshine, and the small-winged, heavy-bodied moths, which fly in the cooler night air, are examples of the same general principles. Possibly the light day-flying and heavy night-flying beetles might be studied to advantage, and even it might be worth while to enquire if all the large-winged insects of the tropics are in reality the expressions of tropical luxuriance rather than evidences of the relative low density of the hot tropical air in which they fly.

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NOTES ON SOME MISCELLANEOUS COLEOPTERA, WITH DESCRIPTIONS OF NEW SPECIES. PART VI.[1]

By Arthur M. Lea, F.E.S.

(Contribution from the South Australian Museum.)

[Read June 10, 1926.]

HYDROPHILIDAE.

Hydrochus.

Specimens of this genus, when in perfect condition, are usually polished and sometimes beautifully metallic, but they are frequently so coated with mud that the colour and sculpture are obscured, and it is difficult to separate the species with certainty. When dried the mud clings so closely to the derm that the cephalic grooves, prothoracic foveae, and the punctures generally, appear to be greatly reduced in size, and it is difficult, if not impossible, to clean the specimens so as to bring the derm back to its untarnished condition. Blackburn considered the coating of one species to be "some kind of exudation."

Hydrochus horni, Blackb., and H. interioris, Blackb.

In the original descriptions of these species *H. horni* was noted as *"niger"* and $1\frac{2}{5}$ lines in length; *H. interioris* as *"obscure viridis"* and $1\frac{1}{5}$ lines in length. There are in the South Australian Museum cotypes of both species from Paisley Bluff, but the cotype labels were accidentally reversed, this is rendered quite clear by the descriptions of colour and size and also by the numbers attached to the specimens; in his note-book No. 5488 was entered, when described, as *horni*, but later on the specimens were labelled as *interioris;* similarly No. 5489 was noted in the book as *interioris*, and on the specimens as *horni*. The mistake is to be regretted as Blackburn subsequently commented upon *horni* under the name of *interioris*[2] and wrongly placed both species in the table; thus on page 227 *interioris* should be read for *horni*, and on page 228 *horni* for *interioris*.

Hydrochus serricollis, n. sp.

Black, elytra dingy reddish-brown, parts of antennae and of palpi, and legs (except knees and parts of tarsi) paler; under surface velvety-black and grey.

Head rather coarsely granulate-punctate, the punctures somewhat smaller on middle of clypeus than elsewhere; with three somewhat shallow but fairly distinct inter-ocular sulci; clypeal suture curved and well defined. Prothorax much wider at apex than at base, about as long as the basal width; densely granulate-punctate, with seven shallow impressions or foveae: four subbasal, three submedian. Elytra with regular rows of large, subquadrate punctures, those in the sutural row smaller than the adjacent ones; fifth interstice feebly elevated almost throughout. Length, 3-4 mm.

Hab.—Tasmania: East and West Tamar, Georgetown, Launceston (Aug. Simson), Strahan (H. J. Carter and A. M. Lea), Devonport (Lea). South Australia: Lucindale (F. Secker). Type, I. 15514.

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[1] Part V. was published in 1919.

[2] Blackb., Trans. Roy. Soc. S. Austr., 1898, p. 228.

The colour and size of the larger specimens are as described in *H. regularis*, but that species was tabulated as having "Head not trisulcate between the eyes." The elytra vary from a rather bright brown to almost, if not quite, as black as the prothorax, the darker specimens as a rule being smaller than the others, on an occasional specimen there is a very faint metallic gloss on the head and prothorax; the palpi are almost entirely black on some specimens. The subfoveate impressions of the prothorax are much more distinct on some specimens than on others, occasionally the two medio-basal ones become feebly conjoined and scarcely traceable; the sides of the prothorax, when a specimen is laid on its back, appear to be serrated throughout, but from above this appearance is less conspicuous.

On this as on most (if not all) Australian species of the genus, there are very large punctures on the abdomen, but they are greatly obscured, or sometimes quite concealed by the velvety indumentum of the under surface; the seventh, eighth, and ninth elytral interstices are also slightly curved and irregular about the middle, with the ninth slightly thickened or elevated there.

Hydrochus brunneonitens, n. sp.

Piceous-brown and shining, elytra obscurely paler, antennae, palpi, and legs still paler; under surface velvety-brown and grey.

Head moderately coarsely punctate; clypeus convex in middle and with smaller punctures than elsewhere; with two rather shallow inter-ocular sulci; clypeal suture wide in middle. Prothorax about as long as the basal width, which is much less than that of apex, sides finely serrated; with four subbasal and three submedian shallow impressions or foveae; densely and rather coarsely punctate. Elytra with rows of large, subquadrate punctures, those in the sutural row smaller than the others; third, fifth, and seventh interstices feebly elevated. Length, 3·25 mm.

Hab.—Queensland (Blackburn's collection). Type, I. 15513.

About the size and general appearance of the preceding species, but cephalic impressions different, and antennae, palpi, and tarsi entirely pale (the femora, however, are somewhat darker than the tibiae and tarsi); it is also about the size and with somewhat similar outlines to those of *H. horni*, but the odd interstices are more noticeably elevated, the prothoracic foveae are larger and the cephalic impressions different; the foveate head is apparently as in *H. obscuroaeneus*, but that species was described as but 2 mm. in length. On the head the sublateral sulci are fairly well defined, but they open out inwardly into the clypeal suture, which between them appears as a rather large fovea, engulfing the median sulcus, and bounded posteriorly by an obtuse carina. From some directions the median fovea of the submedian row, and the two medio-basal ones on the pronotum, appear to be bounded by obtuse costae.

Hydrochus multicolor, n. sp.

Brightly metallic, under surface velvety-black and grey; antennae (club infuscated), palpi (tips infuscated), and legs (knees and tips of claw-joints blackish) more or less flavous.

Head with large punctures, smaller and denser (but quite sharply defined) on clypeus than elsewhere; with three ill-defined longitudinal impressions between eyes; clypeal suture deep. Prothorax almost as long as the apical width, which is much more than that of base, sides finely serrated; with seven subfoveate impressions or areolets: three submedian, and four subbasal, the lateral ones shallowly connected with each other and separated from the median ones by

feeble ridges; with rather dense and coarse punctures. Elytra with regular rows of large punctures, parts of some of the interstices conspicuously elevated. Length, 3·5-4 mm.

Hab.—Victoria: Macedon (H. W. Davey). South Australia: Adelaide (Blackburn's collection). New South Wales: Forest Reefs (A. M. Lea). Type, I. 8286.

The strong partial elevation of some of the elytral interstices is more pronounced than on any other species before me; on *H. victoriae* they are much less pronounced and the general surface is very different; the third interstice is strongly elevated near the base only, the fifth strongly at about the apical fourth, and less strongly elsewhere, and the ninth moderately almost throughout, in the middle between the fifth and ninth the surface is somewhat depressed. The head and prothorax are coppery-green or coppery-blue, or almost entirely golden, the elytra are brightly metallic, but less coppery than the prothorax and head; the Forest Reefs specimen has the head and prothorax purplish-blue, with golden or coppery-green reflections; the Adelaide specimen is like the one from Forest Reefs, except that it is less brightly metallic. On several specimens the median sulcus of the head is scarcely traceable, and the others are not much more distinct, but on the most brilliant specimen all three sulci are quite well defined.

Hydrochus simplicicollis, n. sp.

Bright metallic bluish-green, elytra with coppery and violet reflections; under surface velvety-black and grey; antennae, palpi (tips infuscated), and tarsi reddish-flavous.

Head with three distinct longitudinal impressions between eyes; punctures irregularly distributed, becoming denser on clypeus. Prothorax about as long as the basal width, which is much less than that of apex; with sharply defined but somewhat irregularly distributed punctures, somewhat larger than those between eyes; without subfoveate impressions or areolets. Elytra with regular rows of punctures; the interstices regular, except for the slight curvature of the seventh, eighth, and ninth about middle. Length, 2·25 mm.

Hab.—Queensland: Cairns district (A. M. Lea). Type, I. 8287.

The colour is apparently as in *H. laeteviridis,* but the head on the two specimens before me is quite distinctly longitudinally trisulcate. The clypeus is gently convex throughout instead of rather strongly convex in the middle.

A specimen from New South Wales (Jenolan, J. C. Wiburd) probably belongs to the species, but its upper surface is less brightly metallic, the longitudinal impressions on the head are less distinct, the usual seven impressions on the pronotum are faintly indicated, and part of the fifth elytral interstice is feebly elevated above the adjacent ones. A specimen from Queensland (Bowen, Aug. Simson) possibly also belongs to the species, but is larger (2·5 mm.), its prothorax and elytra are somewhat reddish, with slight metallic reflections, cephalic sulci indistinct (traceable only from a few directions), and prothorax with denser and coarser punctures, with a fairly distinct submedian fovea and others very faintly indicated. Quite possibly, however, additional specimens would indicate that it should not be referred to this species.

Hydrochus scabricollis, n. sp.

Black, shining, parts of appendages reddish, under surface velvety-black and grey.

Head with three short, conspicuous inter-ocular sulci, clypeal suture deep; clypeus rather strongly convex, and with dense but not very large punctures. Prothorax much wider at apex than at base; coarsely granulate-punctate; with

seven fairly large and rough foveae: three submedian and four subbasal, the two medio-basal ones partly conjoined. Elytra with regular rows of large, subquadrate punctures, the odd interstices feebly elevated, but the elevation of the third scarcely traceable. Length, 2·25-2·5 mm.

Hab.—South Australia: Parachilna (H. M. Hale), Lucindale (F. Secker). Type, I. 15511.

A minute black species, with prothoracic sculpture unusually coarse; it is slightly smaller than the average size of the species identified and tabulated by Blackburn as *H. australis*, and the prothorax with decidedly coarser sculpture, elytra shining black, etc.; the original description of *australis*, however, is but a brief comparison with an ex-Australian species, and there is nothing to prove that Blackburn's identification was more than a guess. Parts of the antennae are obscurely pale, the palpi are almost entirely dark, the legs are more or less reddish or obscurely flavous, with the knees and tips of claw joints blackish, occasionally the femora are almost entirely infuscated; the head appears to have four short costae between the eyes, owing to the deep sulci, clypeal suture, and to the depression at the neck.

Hydrochus obsoletus, n. sp.

Black, with a faint purplish gloss; under surface velvety-black and grey; antennae (club slightly infuscated), palpi (tips infuscated), and legs (tips of claw joints infuscated) flavous.

Head with moderately dense, sharply-defined punctures, smaller and denser on clypeus than elsewhere; clypeal suture narrow and ill-defined, inter-ocular impressions very feeble. Prothorax more convex in middle of apex than usual, apex much wider than base, sides finely serrated; with rather dense and coarse punctures and shallow subfoveate impressions. Elytra with regular rows of large punctures; third, fifth, seventh, and ninth interstices feebly elevated in parts. Length, 2·5 mm.

Hab.—New South Wales: Albury (Blackburn's collection). Type, I. 8255.

The inter-ocular sulci are traceable from some directions, but well defined from none, the median one is particularly weak. The prothorax is more convex in the middle of apex than is usual, it has three feeble but traceable subfoveate impressions, slightly in advance of the middle, but of the subbasal row the outer ones are feeble, and the median ones scarcely traceable from any direction. It is not very close to any other species before me, but approaches *H. simplicicollis.*

Hydrochus granicollis, n. sp.

Piceous-brown, head black with a dark metallic-green gloss, under surface velvety-brown and grey; antennae (club slightly infuscated), palpi (tips infuscated), and legs (knees and tips of claw joints slightly infuscated) pale castaneo-flavous.

Head coarsely granulate-punctate, punctures smaller and more crowded on clypeus than elsewhere; clypeal suture curved and well defined, three inter-ocular grooves shallow and faint, but traceable from some directions. Prothorax much wider at apex than at base, sides rather strongly rounded near apex, finely serrated throughout; coarsely granulate-punctate; with seven subfoveate impressions: three submedian and four subbasal, of the latter the two median ones are less defined than the others. Elytra with regular rows of large punctures, the odd interstices slightly but distinctly elevated. Length, 2·25-4 mm.

Hab.—New South Wales: Wahroonga (H. J. Carter). Type, I. 15515.

The prothorax has the rough granulate appearance of that of *H. victoriae*, but the head is wider, the elytral punctures more sharply defined, and the alternate

interstices more evenly elevated. The larger of the three specimens taken by Mr. Carter has the prothorax almost as dark as the head (but not metallic), and the elytra not much darker.

Hydrochus insularis, n. sp.

Black, with a slight purplish gloss; under surface velvety-brown and grey; antennae, palpi (tips infuscated), and legs (knees and tips of claw joints infuscated) of a rather dingy flavous or testaceous.

Head rather coarsely granulate punctate, punctures somewhat smaller and denser on clypeus than elsewhere; inter-ocular sulci feebly defined, clypeal suture rather wide but shallow. Prothorax much wider at apex than at base, sides finely serrated; rather coarsely granulate-punctate, with seven more or less obscure subfoveate impressions: three submedian and four subbasal. Elytra with regular rows of large subquadrate punctures; odd interstices somewhat elevated. Length, 2·25-2·5 mm.

Hab.—Northern Territory: Groote Eylandt (N. B. Tindale). Type, I. 15512.

A small, obscurely metallic species, about the size of *H. interioris*, but punctures not quite as coarse, and third interstice of elytra elevated as well as the other odd ones; in some lights the scutellum has a metallic-green gloss. It is smaller than the species identified by Blackburn as *H. australis*, and the alternate interstices are slightly but distinctly elevated. It is about the size of *H. obscuroaeneus*, but the cephalic and prothoracic impressions are not as in the description of that species. Even when the head has been carefully cleaned its longitudinal impressions are rather indistinct, and when at all dirty the head appears to be without inter-ocular sulci; mud also obscures the prothoracic impressions on most of the (five) specimens obtained on the island.

PSELAPHIDAE.

Palimbolus incisus, n. sp.

♂. Reddish-castaneous; head, prothorax, and antennae (except apical joint) darker. Rather densely clothed with short, pale pubescence.

Head rather elongate, with two small inter-ocular foveae and a longitudinal impression in front; with dense and small punctures. Eyes prominent. Antennae elongate, first joint cylindrical, as long as three following combined, second to seventh slightly longer than wide, eighth subglobular, ninth and tenth larger, their combined length about equal to that of the eleventh, and with it forming a club. Palpi large, apical joint as long as first joint of antennae, and somewhat stouter in middle. Prothorax strongly convex, slightly longer than wide, widest at apical third; with three small foveae near base, one in middle and a larger one on each side; punctures rather small but sharply defined. Elytra about one-fourth longer than prothorax, and at widest (near apex) almost twice its greatest width, with a narrow complete stria on each side of suture, and one extending to about the middle from the base, half-way between suture and shoulder, each stria starting from a small fovea; punctures somewhat larger than on prothorax. Abdomen with upper surface of subapical segment carinated along middle, and with a large fovea on each side, its under surface with a series of shallow depressions. Metasternum with a large horse-shoe shaped impression, bounded by a narrow carina. Legs long; front trochanters and base of front femora acutely dentate, middle femora moderately dentate in middle, upper surface of hind femora deeply incised at basal third; tibiae thin, hind ones each with a thin spur marking the base of a notch at about the apical fifth on the under surface, upper surface with two narrow ridges. Length, 2·75-3 mm.

♀. Differs in having somewhat shorter antennae, subapical segment of abdomen simple, metasternum with depression shallower, not horse-shoe shaped, and open at both ends, hind femora not incised, hind tibiae unarmed and without ridges on upper surface.

Hab.—Queensland: National Park in December (H. Hacker). Type in Queensland Museum; cotype, I. 12293, in South Australian Museum.

Distinct from all previously named species by the hind legs of the male; the armature of the front legs is alike on both sexes.

Palimbolus metasternalis, n. sp.

♂. Reddish-castaneous, elytra, legs (knees excepted), and palpi paler. Clothed with short pale pubescence, and with more or less erect darker hairs.

Head rather elongate, with an interrupted longitudinal impression in middle, a small fovea near each eye; with sparse, irregularly distributed punctures. Antennae moderately long, first joint slightly curved, as long as two following combined, second to sixth about as long as wide, seventh and eighth subtrapeziform, ninth and tenth larger, and forming a club with the still larger eleventh. Prothorax strongly convex, slightly longer than the greatest width (at apical third); with three foveae at basal third, filled with golden pubescence and connected with the base, and one on each side at apical third, the latter invisible from above; with sparse and small punctures. Elytra with a narrow stria on each side of suture, and an oblique impression near each shoulder; punctures minute. Abdomen widely depressed in middle of under surface, subapical segment with a large excavation, bounded on each side by an oblique ridge, four of the segments with a fascia of golden pubescence on each side. Metasternum largely depressed in middle, each side between coxae with a subacute tooth. Legs moderately long; hind trochanters acutely dentate; hind femora much stouter than the others; hind tibiae with a conspicuous V-shaped notch at apex. Length, 3 mm.

Hab.—New South Wales: Dorrigo (W. Heron). Type (unique), I. 12295.

Allied to *P. mirandus* and *P. victoriae*, but spur to hind tibiae differently placed and causing the apex to appear to be notched like a V, the hind trochanters are armed, but not the middle ones, and the metasternum also is armed.

Palimbolus unguiculatus, n. sp.

♂. Reddish-castaneous; elytra (except suture and apex), legs (except knees), and palpi paler. Clothed with pale pubescence and suberect hairs.

Head rather elongate, with a deep narrow impression in front, a fairly large fovea near each eye; punctures irregularly distributed. Antennae rather elongate, first joint cylindrical (except for a slight incurvature near base on upper surface) and as long as second and third combined, second to eighth about as long as wide, ninth and tenth larger, their combined length about equal to eleventh, and with it forming a club. Apical joint of palpi stouter and longer than basal joint of antennae. Prothorax about as long as greatest width, subangularly dilated near apical third, at about basal third with three foveae, the median one connected with the base, each lateral one also connected with the base, and rather obscurely with a small apical fovea, which is invisible from above; punctures sparse and small. Elytra with a narrow stria on each side of suture, and an oblique depression near each shoulder; punctures sparse, small, and irregularly distributed. Abdomen wide, under surface widely depressed in middle, subapical segment with a large depression. Metasternum widely and shallowly depressed in middle. Legs long; hind trochanters acutely dentate; hind tibiae twice notched on the inner side; inner front claw acutely trifid. Length, 2·75 mm.

Hab.—Victoria: Alps (Blackburn's collection). Type (unique), I. 12294.

Of the notches on the hind tibiae the first is at the middle, and its outer end is marked by a small acute projection, the second is smaller and slightly nearer the apex than the first; in *P. leanus* there are two processes on the hind tibiae but they are considerably larger, truncated, and differently placed; the middle tibiae on the present species are also much longer, thinner, and conspicuously curved, the antennae are longer and thinner and the palpi are stouter. The notch on each of the hind coxae is so placed that, from some directions, it, as well as the trochanter, appears to be armed.

In addition to the present species, one of the front claws is trifid in the male in *P. dimidiatus, elegans, frater, leanus, mirandus,* and *victoriae,* and probably in others.

SILPHIDAE.

Clambus semiflavus, n. sp.

Black and flavous. Upper surface glabrous, under surface finely pubescent.

Prothorax and elytra with minute punctures, a very faint stria on each side of suture. Length, ·75 mm.

Hab.—Northern Queensland (Blackburn's collection). Type, I. 15985.

The type has the head, prothorax, antennae, and legs bright flavous, the other parts being intensely black; a second specimen differs from it in having the prothorax flavous at the apex only, but otherwise agrees well with it. Under a microscope the elytra are seen to have numerous small punctures, and a very fine stria on each side of and very close to the suture, but the punctures are just discernible under a lens, and the striae not at all.

SCARABAEIDAE.

Ataenius latericollis, n. sp.

Black, shining, sides of clypeus, palpi, and legs reddish, antennae paler.

Head strongly convex, with moderately dense, sharply defined, but rather small punctures at base, becoming very small in middle, and coarser or subgranulate in front; sides of clypeus shining, and almost impunctate. Prothorax about twice as wide as long, sides feebly rounded, front angles rounded and slightly produced, hind ones obtuse, lateral and basal margins moderate; with numerous sharply defined, but rather small punctures, becoming very small in front, but moderately large and crowded on a distinct depression near each front angle; between depression and base a shining, almost impunctate space. Elytra parallel-sided to near apex, shoulders very feebly armed; striate-punctate, interstices evenly convex, wider than striae, crenulate internally, but on apical slope narrower than striae. Metasternum with a narrow median stria, deep at each end but shallow in middle, no punctures near it, a shallow oblique impression almost without punctures near each hind coxa, sides with sparse punctures, but becoming dense near base. Mesosternum with a very narrow ridge on intercoxal process. Length, 3-3·25 mm.

Hab.—Northern Territory: Groote Eylandt (N. B. Tindale). Type, I. 15449.

A small, strongly convex species, of which twelve specimens were obtained on the island; the general outlines are somewhat as on *A. parvus*, but that species has much sparser prothoracic punctures, and its head is not subgranulate in front. On several specimens the sides of the prothorax, tips of elytra, and their epipleurae, are obscurely reddish, on two the elytra and under surface are entirely reddish, and a greater portion of each side of the prothorax. From some directions the shining impunctate space on each side of the prothorax appears subtuberculate, somewhat as in *A. tweedensis,* and *A. nudus,* but it is much smaller than those

species, and the head is subgranulate. The median stria of the metasternum can usually be traced throughout, but from some directions it appears to vanish in the middle.

A specimen from Connexion Island and one from Normanton probably belong to the species, but are larger (3·5 mm.), sides of clypeus narrower and less shining, shining space on each side of prothorax less defined, and with rather large and conspicuous punctures.

Heteronyx insularis, n. sp.

Dark castaneous-brown, parts of legs somewhat paler, antennae and palpi still paler. Densely clothed with short, depressed pubescence; sides, under surface, and legs with hairs or bristles.

Head with frons and clypeus on an even plane, and similarly densely granulate-punctate; clypeus with apex moderately incurved to middle, the labrum concealed from a slightly oblique point of view. Antennae eight jointed. Prothorax not twice as wide as long, sides strongly rounded, front angles acute and somewhat produced, hind ones almost rectangular; with dense and small, but not confluent punctures. Elytra with punctures much as on prothorax, subsutural and sublateral striae fairly distinct, the others very faint or absent; apical membrane short. Pygidium with somewhat sparser and larger punctures than on elytra. Hind coxae at sides the length of metasternum; claws appendiculate. Length, 10-10·5 mm.

Hab.—Northern Territory: Groote Eylandt (N. B. Tindale). Type, I. 15485.

At first glance this species somewhat closely resembles *H. xanthotrichus* (Group 8), but it is quite certainly a member of Group 2, although it appears to have no close allies in it; in Blackburn's table of that group it could be placed in A, BB, C. Of the two species of C, it differs from *H. torvus* in not being black, in the incurvature of apex of clypeus, prothoracic punctures much smaller and denser, apical membrane of elytra much shorter, etc.; from *H. hispidulus* it differs in being smaller, with much smaller, denser, and very different punctures, in the clypeus, clothing, etc. There are no erect hairs on the disc of the prothorax or elytra, the prothorax has a rather long fringe on each side, and a few hairs (abraded from most of the specimens) across the apex; the lateral fringe on each elytron becomes shorter posteriorly, and terminates level with the side of the pygidium, on the pygidium there are a few erect setae in addition to the pubescence; the hairs on the metasternum are fairly dense and soft (contrasted with the stiff bristle-like ones about the shoulders). The appendix to each claw is large and more or less membraneous, a narrow notch intervenes between it and the hooked tip; on the front tarsi of the male the membrane is larger and more conspicuous. Two females are much paler (rather pale castaneous) than two other females and a male.

Heteronyx irrasus, n. sp.

Dark piceous-brown, almost black, the elytra obscurely paler than the rest of the upper surface, legs obscurely reddish, antennae somewhat paler. With rather long, sloping, and not very dense pubescence, interspersed with numerous erect hairs, lateral fringes rather long.

Head with frons feebly separately convex; with dense (but not confluent) large punctures, the interspaces with minute ones; clypeus with crowded and smaller granulate punctures; labrum (as seen from behind) scarcely half the width of a lateral lobe. Antennae eight jointed. Prothorax more than twice as wide as long, sides moderately rounded, front angles slightly produced, hind ones gently rounded off; punctures (for the genus) rather sparse, nowhere confluent, much smaller than on head. Elytra with large rough punctures, the interspaces

with minute ones, subsutural and sublateral striae only fairly distinct; apical membrane rather short. Pygidium shagreened and with fairly large but rather indistinct punctures. Hind coxae at sides longer than metasternum; claws acutely bifid. Length, 7·5-7·75 mm.

Hab.—Northern Territory: Groote Eylandt (N. B. Tindale). Type, I. 15486.

The claws are distinctly bifid, so the species can only be referred to Blackburn's Group 5, and there it would be associated with *H. capillatus* and *H. placidus*, from both of which it is distinguished by its much smaller size; its prothoracic punctures are somewhat as in *placidus*, but the sides of the clypeus are more rounded, and the punctures on the frons are less crowded. There are specimens in the Museum of all the species referred by Blackburn to Group 5, and it is not close to any of them. The elytral punctures are larger than those on the head, but sparser, many of them are squamose (as defined by Blackburn), and a few in places are feebly transversely confluent. Two specimens were obtained.

Heteronyx glaber, n. sp.

Pale castaneous and shining, elytra, abdomen, antennae, palpi, and parts of legs flavous, or pale flavo-castaneous; suture, extreme margins of prothorax, knees, and some narrow parts of legs dark (occasionally almost black). Prothorax and elytra fringed, rest of upper surface glabrous.

Head gently convex between eyes, with small and sharply defined punctures, nowhere crowded together; clypeus roughly granulate, suture rather strongly arched backwards in middle; labrum almost or quite as wide as a lateral lobe. Antennae nine jointed. Prothorax more than twice as wide as long, sides evenly rounded, front angles moderately produced, hind ones gently rounded off; punctures somewhat sparser, but otherwise much as on head. Elytra with sharply defined punctures of moderate size, and nowhere crowded, although denser about apex than elsewhere; subsutural and lateral striae distinct; apical membrane very short. Pygidium with punctures much as on head but more crowded. Sides of hind coxae distinctly longer than metasternum, and with somewhat larger and sparser punctures; claws acutely bifid. Length, 5-6·5 mm.

Hab.—Northern Territory: Groote Eylandt (N. B. Tindale). Type, I. 15487.

A small, pale, highly polished, glabrous species, which in Blackburn's table of Group 7 would be associated with *H. viduus*, to which it is certainly very close, but from which it differs in being of a smaller average size, in having smaller punctures on the prothorax, and the third tooth of the front tibiae smaller (almost reaching the vanishing point, although acute). The smooth frons in strong contrast with the granulated clypeus is as in *H. viduus*, and several allied species; *H. pauxillus*, which also occurs on the island, differs in having considerably larger punctures on the prothorax and elytra, and the clypeal suture not angularly drawn backwards in the middle. Most of the metasternum is glabrous, each of the visible abdominal segments has a row of stiff setae, continuous across the middle in male, interrupted there in the female. The labrum when viewed obliquely from behind appears to be slightly elevated above the clypeus, when viewed at a right angle from above its front face appears to be very feebly incurved to the middle. Nearly fifty specimens were obtained, and they vary slightly in colour, but the elytra are always paler than the rest of the upper surface.

Heteronyx minimus, n. sp.

Flavous and shining, elytra slightly paler than the rest of upper surface. Upper surface glabrous, except for straggling lateral fringes.

Head with sparse and small punctures on frons; clypeus roughly granulate, suture almost straight; labrum almost as wide as each lateral lobe. Prothorax,

elytra, pygidium, hind coxae, and claws as described in preceding species. Length, 3·5-4 mm.

Hab.—Northern Territory; Groote Eylandt (N. B. Tindale). Type, I. 15488.

The smallest known species of the genus. In Blackburn's table of Group 7 it would be associated with *H. pauxillus,* from which it differs in its much smaller size and finer prothoracic punctures; although only three specimens of that species were known to Blackburn, I have seen over a dozen, and the differences noted are constant; *H. lividus* is not much bigger, but has much coarser punctures on the frons and pronotum. Structurally it is close to the preceding species, but is paler, the size is consistently smaller, and the clypeal suture is almost straight. The clypeus usually has a slightly more reddish appearance than the frons. Nineteen specimens were obtained.

Heteronyx distortus, n. sp.

♂. Of a rather dingy, pale flavo-castaneous, elytra, abdomen, and antennae paler. Prothorax and elytra with straggling lateral fringes, rest of upper surface glabrous or almost so.

Head with frons gently convex and subopaque; with small but sharply defined punctures; clypeus granulate-punctate in middle, with sparse punctures at sides, suture almost straight; labrum about three-fourths the width of a lateral lobe. Antennae nine jointed. Prothorax opaque, more than twice as wide as long, sides strongly rounded, front angles slightly produced, hind ones rounded off; punctures minute, only the piliferous lateral ones at all distinct. Elytra with sharply defined and mostly rather small punctures, fairly dense about apex, but sparser elsewhere; subsutural and lateral striae distinct, faint remnants of others traceable. Pygidium subopaque and sparsely punctate. Sides of hind coxae about as long as metasternum, and with much sparser punctures; third tooth of front tibiae very small; claws appendiculate, front ones enlarged and asymmetrical. Length, 6-7·5 mm.

♀. Differs in having denser and somewhat coarser punctures on head, abdomen more convex, front claws normal, and hind tarsi differently setose.

Hab.—Northern Territory: Groote Eylandt (N. B. Tindale). Type, I. 15489.

Belongs to Blackburn's Group 8, and has remarkable claws much as on *H. scutatus,* but is a consistently much smaller species (9 of the present form and 26 of that one are before me) and narrower, with the prothorax (unless greasy) quite opaque. It has the general appearance of *H. pauxillus* (Group 7). At first glance the elytra (except for the fringes) appear to be glabrous, but when viewed from the sides remnants of pubescence may usually be seen on the apical slope; on several specimens, however, the disc is certainly glabrous, but probably owing to abrasion; there are a few hairs on the metasternum and a row of bristle-like ones across most of the abdominal segments. The appendix to each claw is large and its apex is not far from rectangular (from some directions, however, the claws appear bifid), but on the male the front claw joint is ridged along middle, the ridge appearing subspinose at apex, its outer claw is somewhat larger, but otherwise much as those on the other tarsi, but the inner one is greatly enlarged, set at a different angle, suddenly bent backwards, and with a large and differently formed appendix; the hind tarsi of the female has, proceeding from the upper apex of the third and fourth joints, two or three stout curved bristles (much stouter than those on the under surface), the claw joint usually has one, so that it appears to have one simple claw and two appendiculate ones. Five specimens were obtained on the island, and Mr. J. Clark sent for examination four others taken by Mr. W. Crawshaw at Wyndham.

Haplonycha longipalpis, n. sp.

Dark castaneous-red with a slight pruinose gloss, elytra flavous and slightly iridescent, suture and margins darker. Sterna and base of abdomen with rather dense pale hair, prothorax with a lateral fringe of long hairs; pygidium with rather sparse long setae, or short hairs, and an apical fringe.

Head with dense, sharply defined punctures, coarser near clypeal suture than elsewhere, the intervening spaces with minute punctures; clypeus with sparser punctures than on rest of head, and coarsest near its suture. Antennae nine, club three jointed, joints of the club slightly longer than five preceding joints combined. Palpi unusually long, apical joint thin, about as long as basal joint of antennae, with a narrow, distinct impression on its upper surface near base, penultimate joint slightly shorter than antepenultimate. Prothorax about thrice as wide as the median length, sides strongly rounded, front angles acute and moderately produced, hind ones rounded off; with sparse and small punctures; lateral gutters rather wide and filled with piliferous punctures; apical membrane rather long at the sides, short in middle. Elytra with sides rather strongly rounded and widest at about the basal two-fifths; punctures rather small; each with four distinct but feebly elevated discal costae, marking the positions of geminate striae, containing not very closely placed punctures. Pygidium unusually wide, strongly convex in middle, thence moderately ridged to apex. Basal joint of hind tarsi slightly shorter than second. Length, 32 mm.

Hab.—Northern Territory: Groote Eylandt (N. B. Tindale). Type, I. 15475.

The lateral gutter of its pronotum "filled with closely-packed setiferous punctures (especially round hind angles)" renders it certain that this species should be referred to Blackburn's Group 2; the lateral fringes on the prothorax of the type are somewhat abraded, but the species is very distinct from *H. latebricola, H. trichopyga, H. crassiventris,* and *H. punctulata* by the apical joint of its palpi, this is unusually long and thin, with a basal depression; from all the previously described species of Group 3 (apart from the prothorax), it differs in its much greater size. In general appearance it resembles *H. latebricola* (Group 2), *H. colossa* (Group 4), and *H. gigantea* (Group 5). The elytra have a complete downward projecting fringe of very short golden setae, and an outward projecting one (not traceable across apex) of longer, reddish setae, becoming rather short posteriorly.

Haplonycha tindalei, n. sp.

Pale reddish-castaneous, head somewhat darker, elytra (sides and suture narrowly excepted) and abdomen flavous, some marginal parts of legs blackish. Sterna moderately pilose.

Head with fairly large and dense punctures, more crowded about clypeal suture than elsewhere, the latter distinctly bisinuate. Antennae nine, club four jointed, fifth joint acutely produced internally; club about as long as three basal joints combined. Palpi with apical joint rather long and cylindrical, antepenultimate joint slightly longer and stouter than penultimate. Prothorax scarcely more than thrice as wide as the median length, sides strongly rounded, front angles acutely produced, hind ones rounded off; punctures close behind the subapical furrow about as large as the inter-ocular ones, but shallower and sparser elsewhere; apical membrane moderately long at sides, very short in middle. Elytra widest at about basal two-fifths; with fairly dense, sharply defined punctures, the geminate rows well defined, the space between each pair very feebly elevated and impunctate or almost so; suture briefly mucronate. Pygidium rather strongly convex, ridged posteriorly, surface faintly wrinkled, and with small and very small punctures; propygidium shagreened and opaque, but shining and with

distinct punctures near suture. Basal joint of hind tarsi distinctly longer than second. Length, 20-23 mm.

Hab.—Northern Territory: Groote Eylandt (N. B. Tindale). Type, I. 15478.

In Blackburn's table of Group 5 belongs to AA, BB, CC, but I cannot follow his D and DD (the edging to the basal and lateral gutters on the pronotum is practically even throughout, although the gutters themselves are wider at the front angles and position of the hind ones than elsewhere); of all the species he referred to DD there are specimens in the Museum, and it is certainly different from all of them; if referred to D it would probably be associated with *H. arvicola* (its prothoracic punctures are certainly much sparser and somewhat smaller than on *H. rustica)* from the description of which it differs notably in its constantly bicoloured upper surface. The prothorax has a few hairs in the lateral gutters, but they are so sparsely spaced that they could not be regarded as forming a fringe; on the apparent basal segment of abdomen there is a row of setiferous punctures, that extends across the segment, each of the three following segments has a remnant only of a row on each side; the fringe on each side of the elytra is composed of reddish, rather distantly placed setae; the pygidium, except for a few apical hairs, is quite glabrous; the hind coxae have sharply defined and mostly setiferous punctures. The sexes differ but little externally, in the male the joints of the club extend backwards to well beyond the middle of the basal joint of antennae, in the female they scarcely pass its tip. Specimens were taken abundantly at lights, during the wet season, and relished by a flying phalanger in captivity.

Haplonycha bidentipes, n. sp.

Pale reddish-castaneous, elytra (suture and margins excepted) and parts of under surface of a rather dingy flavous. Sterna (for the genus) sparsely pilose, a feeble fringe of hairs on each side of prothorax, elytra with outward projecting fringe of setae rather distantly spaced, the basal setae fairly long, becoming short posteriorly; downward projecting fringe very short and inconspicuous; four segments of abdomen each with a transverse row of setiferous punctures; pygidium with fringing hairs only.

Head rather convex and with sparse and minute punctures; clypeus rather shorter than usual, middle of base obtusely elevated (the part of the head immediately behind it depressed); punctures very sparse and small, suture strongly bisinuate; front face very short (only about half the length of labrum) and with isolated, setiferous punctures. Antennae nine, club three jointed. Apical joint of palpi rather thin, penultimate joint slightly shorter than antepenultimate. Prothorax scarcely four times as wide as long, sides strongly and evenly rounded, front angles produced and somewhat acute, hind ones rounded off; punctures small and rather sparse; apical membrane rather short near eyes, very short elsewhere. Elytra somewhat dilated to beyond the middle; punctures (including those in the geminate rows) well defined and rather numerous; suture unarmed. Pygidium with dense and minute punctures, or somewhat coarsely shagreened. Front tibiae strongly and acutely bidentate; hind tarsi with two basal joints almost equal. Length, 9·5-11 mm.

Hab.—Northern Territory: Groote Eylandt (N. B. Tindale). Type, I. 15483.

Almost the smallest of the genus, and looking somewhat out of place in it, but by Blackburn's generic table of the Melolonthides (3) it could only be referred to *Colpochila (=Haplonycha);* the complete absence (even of a faint undulation at its position) of a third tibial tooth, may be regarded as a generic feature.

(3) Blackb., Trans. Roy. Soc. S. Austr., 1898, p. 32.

although in many species of the genus it is quite small.[4] There are but few punctures across the front face of the clypeus, and as they are not confused by other punctures there need be no hesitation in referring the species to Blackburn's Group 7, where it would be associated with *H. testaceipennis,* to which, however, it is not at all close. The prothorax, scutellum, and elytra are finely and evenly shagreened, and moderately shining, the head behind the clypeal suture is less evenly shagreened and slightly more shining, the clypeus is non-shagreened and polished. The obtuse median elevation, of the clypeus, is rendered more conspicuous by a depression on the head immediately behind the suture. The joints of the club are slightly longer than the three basal joints of antennae in the male: in the female they are slightly shorter than those joints; these apparently being the only external indications of sex. Numerous specimens were obtained.

Haplonycha minuta, n. sp.

♂. Reddish-castaneous and with a slight pruinose gloss; elytra and abdomen paler, but suture, sides, and base of the former coloured as scutellum. Sterna with fairly dense pale hairs.

Head with dense and moderately large punctures, sparser on clypeus than between eyes. Antennae nine, club three jointed, joints of club as long as rest of antennae. Apical joint of palpi rather long, flattened and subopaque on upper surface near base, penultimate joint shorter than antepenultimate. Prothorax between three and four times as wide as the median length, sides inflated and strongly rounded towards base, front angles slightly produced, hind ones widely rounded off; punctures considerably sparser and smaller than on head, a row of sparse piliferous punctures in each lateral gutter; apical membrane very short, even near eyes. Elytra with well-defined geminate rows of punctures, the interstices, except between the geminate pairs, with fairly numerous ones, but becoming irregular and somewhat crowded posteriorly; subsutural stria rather deep. Pygidium rather strongly convex; with fairly numerous, but not very sharply defined punctures. Two basal joints of hind tarsi subequal. Length, 10 mm.

♀. Differs in being larger (10·5-11 mm.), somewhat wider posteriorly, joints of club shorter than rest of antennae, and pygidium with an obtuse, shining, median elevation.

Hab.—Northern Territory: Groote Eylandt (N. B. Tindale). Type, I. 15484.

The ocular canthi cutting well into the eyes, and the base of prothorax narrowly margined throughout, exclude this species from *Pelinopus* and *Neso,* so at present it can only be referred to *Haplonycha,* despite its small size. It differs from *H. bidentipes* in being more convex, darker, front tibiae tridentate, head with larger and crowded punctures, etc. The front face of the clypeus has a row of large, distinct, piliferous punctures, but on the sides there are many others, the front face also has numerous smaller, but sharply defined punctures; so that the characters given by Blackburn for his Groups 6 and 7 do not exactly apply, and in fact very few of the species that quite evidently belong to F, of his table, exactly fit either 6 or 7. The outward projecting row of setae or hairs on each side of the elytra is distinct, but there is no trace of a downward projecting fringe, or fine membrane; the propygidium is rather densely pubescent, and there are remnants of pubescence on the pygidium; the tip of the latter is conspicuously fringed. Seen obliquely from behind, the base of the clypeus appears conspicuously elevated above its suture, especially in the middle. The sixth joint of antennae is very short, and could easily be overlooked. The elytra of the male,

[4] In *Glossocheilifer bidentatus* the front tibiae are also bidentate, but on that species the labrum is produced, this being its only generic distinction from *Haplonycha.*

as viewed from above, appear to be parallel-sided to near the apex, but from the sides they appear widest at the basal third, and thence rather strongly narrowed to apex. The pygidium is opaque, and as a result its punctures are somewhat masked. Five specimens were obtained on the island.

Form 2. Six specimens from Melville Island (W. D. Dodd) probably represent another form of the species; they differ in having the elytra somewhat darker, so that the bicoloured appearance of the upper surface is less conspicuous, the head has more crowded punctures, the clypeus is less conspicuously elevated at the middle of its base, the pygidium of the female is without a distinct submedian elevation, and is shining and with distinct punctures throughout; the smaller punctures on the front face of its clypeus are very few in number (so that it could fairly be regarded as belonging to Blackburn's Group 7), and the coarse lateral ones are larger.

Form 3. Five specimens from Darwin (N. Davies), probably represent another form of the species. They are smaller (8·5-9·5 mm.), and somewhat darker (although the elytra are still not quite as dark as the rest of the upper surface); the clypeus is not at all elevated at the base, although its suture is deep and well defined; the elytral punctures, both in the rows and on the interstices, are somewhat larger than on the other forms. The pygidium and the front face of the clypeus are much as on Form 2.

In Blackburn's generic table of the Sericoides [5] the character "Elytra geminate-striate" needs some amplification; on some species of *Colpochila* (=*Haplonycha)*, and occasionally in other genera, the elytral punctures are sometimes in double rows, but the rows are not necessarily in striae, the punctures being separately impressed at more or less regular intervals; on some species the striae are well defined, but contain no punctures. On the present species the rows of punctures are quite well defined (although the distance separating the rows of each pair is more than is usual in the genus, rendering the gemination less conspicuous), but the striae (except the subsutural one) are very slightly impressed in parts, and not at all elsewhere.

Lepidiota flavipennis, n. sp.

Dark brown, almost black, shining, antennae, palpi, and legs castaneous, abdomen paler, club of antennae and elytra flavous, suture infuscated. Clothed with snowy-white scales, front part of metasternum, in addition, with long pale hairs; legs with rather sparse hairs and white scales.

Head with rather large punctures, somewhat unevenly distributed, the intervening spaces with minute ones. Clypeus short, rather feebly bilobed, margin moderately upturned. Club of antennae rather small. Apical joint of palpi rather long, tip not hooked, upper surface with an elongated, flat (but not concave), opaque space. Prothorax rather long, sides almost acutely dilated slightly nearer base than apex, obtusely crenulated, front angles slightly obtuse, hind ones more strongly so, front and hind margins not elevated; with large, irregularly distributed punctures, and a few minute ones. Elytra almost parallel-sided to near apex, suture narrowly raised and slightly produced at tips; punctures almost evenly but sparsely distributed; derm in places feebly wrinkled. Propygidium with a bisinuate depression marking the tips of elytra, beyond this with dense and small punctures; pygidium with sparser and larger punctures and some minute ones. Front tibiae strongly tridentate, median tooth very slightly nearer third than first. Length, 19-20 mm.

Hab.—Northern Territory: Groote Eylandt (N. B. Tindale). Type, I. 15472.

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(5) Blackb., Trans. Roy. Soc. S. Austr., 1898, p. 33.

Structurally close to *L. darwini,* but the propygidium has a conspicuous impression, continuing the line of the junction between the upper and lower surfaces of abdomen; the hind parts are also much less densely clothed; on that species they are so plated with scales that it would be difficult to put another one on without its overlapping others, on the present species their clothing is more of the nature of depressed setae, which are rather thinly scattered over the surface; the palpi also differ. Few of the scales are quite circular; on the head each is contained within a large puncture, on the prothorax they are larger than elsewhere, dense on the sides and parts of the base and apex, crowded in the hind angles, and sparse elsewhere, much of the discal portion being glabrous; they are rather sparse but almost evenly distributed on the elytra, dense and small on the propygidium, much sparser and thinner on the pygidium, whose tip has a few hairs or thin setae, closely cover the sterna and hind coxae, and are dense on the abdomen, except adjacent to its sutures; the outer edges of the elytra are fringed with thin white scales or short setae, giving them, in some lights, a finely serrated appearance. The large punctures are almost absent from the middle of the clypeus, and from some other parts of the head. Three specimens were obtained.

Lepidiota lepidosterna, n. sp.

Blackish-brown, some parts quite black, parts of elytra obscurely paler, antennae, palpi, and parts of legs castaneous. With snowy-white scales, moderately clothing the upper surface, denser on the hind parts, and completely plating the sterna, hind coxae and most of the abdomen; legs with sparse hairs, the femora with rather dense scales, and almost hairless.

Head with coarse, crowded punctures, but almost absent from middle of clypeus, where, however, the surface is finely wrinkled and with dense and minute punctures. Club of antennae rather small. Apical joint of palpi rather long and thin, its tip not hooked, upper surface with a feeble, elongate, subopaque space. Prothorax rather long, sides strongly dilated and widest slightly nearer base than apex, obtusely crenulated, front angles acutely produced, hind ones obtuse but not at all rounded off, basal and apical margins not elevated; with fairly dense punctures, becoming crowded towards sides. Elytra with sides moderately dilated about middle; with rather dense and fairly large punctures, many of which are obliquely or transversely confluent, owing to wrinkling of the derm. Hind parts with dense punctures; pygidium faintly shagreened. Front tibiae strongly tridentate, middle tooth slightly nearer third than first. Length, 17 mm.

Hab.—Northern Territory: Groote Eylandt (N. B. Tindale). Type, I. 15473.

With the general appearance of *L. rothei,* but on all the many specimens of that species before me, the propygidium is clothed only on its lower part; on the present species it is conspicuously clothed throughout; it differs from *L. grata* in being smaller, clypeus less strongly bilobed, punctures of pygidium not quite so crowded, and clothing of propygidium changing from scales to setae quite close to base, instead of near apex; *L. degener* is a smaller species, with sides of prothorax strongly crenulated, and less angularly dilated in the middle. There are no hairs on any part of the sterna, on which the scales have a beautiful pearly lustre, they are rather wider there and on the abdomen than on other parts, but few of them are quite circular; on the left side only of the abdomen, and on parts of the pygidium of the type, some of the scales have a yellowish stain. The punctures on the head are unusually coarse, especially adjacent to the clypeal suture, but on the clypeus itself there are less than thirty of them; on the type part of the normally concealed base of head is exposed, and is seen to be highly polished and with small sparse punctures.

Liparetrus simulator, n. sp.

Black, prothorax with a slight metallic gloss; elytra flavous, base, apex, suture, and sides black or blackish; antennae (club partly infuscated), palpi, most of front legs and pygidium reddish. Under surface with dense whitish hair, propygidium and other parts of abdomen with dense white pubescence as well, head between eyes and prothorax with rather dense hair, somewhat darker than on under surface.

Head with crowded and fairly large punctures, becoming longitudinally confluent both in front of and behind clypeal suture. Clypeus feebly diminishing in width to apex, which is gently incurved to middle, and with angles moderately rounded. Antennae nine jointed. Prothorax with front angles moderately produced, hind ones rounded off, sides subacutely produced, median line absent; punctures rather inconspicuous. Elytra very short. Hind parts with rather dense asperate punctures, almost concealed by pubescence on the propygidium. Front tibiae unidentate, the apical process long and acute; hind tarsi with first joint conspicuously longer than second. Length, 6·5-7·5 mm.

Hab.—Northern Territory: Groote Eylandt (N. B. Tindale). Type, I. 15464.

Belongs to Blackburn's Group 12, and would be there associated with *L. sericeipennis*, which was described as having the front tibiae "rather strongly bidentate"; in general appearance it is strikingly close to *L. discipennis*, and *L. canescens* (of Group 11), but the elytra are quite glabrous; in appearance it is very close to *L. occidentalis*, which has the even curve of the front tibiae interrupted by a small tooth, and the two basal joints of the hind tibiae almost equal in length; *L. cinctipennis* is similarly coloured, but has prothorax and hind parts very differently clothed; *L. bimaculatus* has the hind parts very differently clothed, and much less of elytra pale. Of four specimens taken on the island one has the elytra opaque from every point of view, one has them opaque from most directions, but from almost directly above they have a beautiful golden gloss; on the third they are shining (even the black parts) from almost every point of view; the fourth specimen was badly damaged by grease; when they appear to be shining their punctures are also sharply defined, and are seen to be in geminate rows with numerous scattered ones on the interstices; but when the elytra appear to be opaque, their punctures are scarcely visible. The prothoracic punctures on two specimens are scarcely visible, although they are not particularly small, but on the other two they are rather sharply defined. The clypeus is but feebly concave, as the sides are only slightly elevated, and the apex not at all.

Pseudoryctes bidentifrons, n. sp.

♂. Deep black and shining, most of under surface, parts of legs, and of antennae reddish. Under surface and legs with long stramineous, or reddish hair, in places changing to bristles.

Head small and impunctate between eyes; clypeus with suture feebly elevated, sides and front acutely margined; with rather coarse punctures; canthi with rather coarse punctures. Antennae ten jointed, three joints of club as long as the rest combined. Prothorax strongly transverse; with a wide and deep cavity occupying most of the surface, the cavity glabrous and with numerous transverse scratches; in front with two small triangular teeth, each side of cavity in middle with a strong elevation, feebly bifid at its summit, just below each of these a small projection. Scutellum with a few punctures. Elytra slightly wider than long, slightly narrower than prothorax; feebly wrinkled and with a few inconspicuous punctures; with a distinct stria on each side of suture, and a feeble marginal one. Length, 15-18 mm.

Hab.—Northern Territory: Borroloola, three males (G. F. Hill). Type in National Museum.

A jet-black species, readily distinguished from all previously recorded from Australia by the two small and rather widely separated projections in front of the prothorax, these not being in any way conjoined, but separated by an incurved space almost equal to the distance between the eyes. The elytra have a close-set posterior fringe; and the pygidium is crowned with a longer and looser one.

OEDEMERIDAE.

Pseudolycus laticornis, n. sp.

♀. Black, in parts with a slight coppery gloss; elytra brick-red, the suture and sides to near apex narrowly black; cheeks in front of eyes, most of ninth joint of antennae, and base of tenth, dingy whitish. Densely clothed with short pubescence, similar in colour to the derm on which it rests, except that there is a small oblique golden spot on each side of prothorax.

Head obliquely flattened in front; with small, dense, partially concealed punctures. Antennae moderately long, third to seventh joints wide and flat, third triangular, fourth and fifth with sides more rounded towards base, sixth narrower, seventh still narrower, but at least one-third as wide as long, the others much narrower, eleventh semidouble. Prothorax about as long as the greatest width (across the apical third), with three shallow depressions: one at base and one on each side at apical third; punctures as on head. Elytra much wider than prothorax, parallel-sided to near apex, each with four discal costae, of which the second and fourth terminate slightly nearer the apex than the others; with small crowded punctures. Length, 8-10 mm.

Hab.—New South Wales: Dorrigo (W. Heron). Queensland: Glen Lamington (Dr. E. Mjoberg). Type, I. 12238.

In general appearance like the variety *rufipennis* of *P. haemorrhoidalis,* but shorter and more compact, prothorax with two small, oblique, marginal spots of golden pubescence, part of the cheeks and of the eighth joint of antennae whitish; in *P. bivitticollis* the prothoracic markings are almost parallel, and extend from base to apex; *P. haemopterus* is a narrower species, with deeper prothoracic impressions, etc. The black part of the suture is very narrow on the basal half and at its widest part does not quite extend to the subsutural interstice; the black margin is widest at its base, and is narrowed posteriorly, they all terminate slightly before the tips of the costae.

Pseudolycus megalops, n. sp.

♂. Black, in parts with a slight coppery gloss, elytra flavous, the suture and sides narrowly black, seventh and eighth joints of antennae partly whitish. Densely clothed with short ashen or white pubescence.

Head obliquely flattened, and gently concave between eyes, these unusually large and prominent; with small dense punctures. Antennae rather long and thin, third to sixth joints somewhat flattened, eleventh semidouble. Prothorax slightly longer than the greatest width (near apex), with three large and fairly deep impressions: one basal, one on each side near apex; punctures as on prothorax. Elytra much wider than prothorax, parallel-sided to near apex, each with four discal costae, of which the third is scarcely traceable beyond the middle; with small crowded punctures. Length, 7-8 mm.

Hab.—New South Wales: Dorrigo (W. Heron). Type, I. 12237.

The antennae are thinner than in *P. hilaris* and *P. carteri,* and the eyes are larger and more prominent, the antennae are about the thickness of those of the male of *P. haemopterus,* but the eyes are much larger, the width across them

being equal to that of the base of the prothorax. On the type the base of each tibia and of the basal joint of antennae is very obscurely diluted with red.

Pseudolycus basiflavus, n. sp.

Black; inter-antennary space and base of head, prothorax, scutellum, basal sixth of elytra, prosternum, part of mesosternum, and parts of legs flavous. Densely clothed with short pubescence, dark on the dark parts, white on the pale.

Head gently convex; with small dense punctures; muzzle rather long, the jaws notched at apex. Antennae rather long, second to ninth joints cylindrical (the others missing). Prothorax about as long as the greatest width (across apical third), with a shallow depression at base, and another on each side near apex; punctures inconspicuous. Elytra much wider than prothorax, shoulders strongly rounded, sides parallel to near apex; each with two discal costae: punctures dense and small. Length, 6 mm.

Hab.—Queensland: Cairns district (F. P. Dodd). Type (unique), I. 12239.

The markings are very different from those of any other known Australian species of the family. This species would possibly have been regarded by Blackburn as belonging to a new section of *Copidita*, but he appeared to be unaware of the great variation in the antennae of *Pseudolycus*, to which genus I think the present species should be referred. The front and middle coxae and base of front femora are brightly flavous, the hind coxae and parts of middle and of hind femora obscurely flavous. The type is probably a female.

Pseudolycus fasciatus, n. sp.

Black and flavous. Rather sparsely clothed with short pubescence, except on elytra, where it is dense.

Head moderately convex, a small fovea each side near eye; with small and rather dense punctures; jaws notched at apex. Antennae rather long and thin, third to tenth joints cylindrical, eleventh semidouble and slightly shorter than tenth. Prothorax slightly longer than the greatest width (near apex), with a shallow transverse impression near base, and a deeper one on each side near middle; punctures as on head. Elytra much wider than prothorax, parallel-sided to near apex, each with two feeble discal costae, and traces of still more feeble ones; with small and very dense punctures. Legs long and thin. Length, 5·5 mm.

Hab.—New South Wales: Acacia Creek (H. J. Carter). Type (unique), I. 12240.

Strikingly different from all other known species of the genus, and at first glance much like some species of *Telephorus* and *Selenurus*, of the Malacodermidae; it would probably have been referred to a section of *Copidita* by Blackburn. The flavous parts are the parts of the head about the base of each antenna, prothorax (except for a wide, black, submedian fascia), elytra (except for narrow spaces at base and apex, and a fascia near apex—the space between the apex and subapical fascia more brightly flavous than elsewhere, the part between the subapical and basal black markings clothed with rusty-red pubescence), parts of prosternum and of mesosternum, four basal segments of abdomen, coxae, half of middle femora and less of the others, and base of tibiae.

CURCULIONIDAE.

Leptops mirabilis, n. sp.

Black. Densely clothed with light-brown substramineous scales, and, in addition, with numerous setae.

Head somewhat flattened between eyes; inter-ocular fovea very narrow. Rostrum stout, with aberrant sculpture. Prothorax slightly longer than wide,

sides feebly rounded; with numerous obtuse tubercles, with a shallow medio-frontal impression and a feeble median node. Elytra with shoulders oblique, sides feebly increasing in width to about middle; with large but (except on sides) mostly shallow and ill defined punctures; suture, third, fifth, and seventh interstices obtusely tuberculate. Legs long; front tibiae conspicuously flattened, grooved on each side and lightly denticulate. Length, 19 mm.

Hab.—Lord Howe Island.

One of the most remarkable species of the genus; in the 1906 table it would be associated with those referred to G, from all of which it is very different; it is one of the very few species whose prothorax, by measurement, is seen to be actually a trifle longer than wide. On the elytra most of the setae are confined to the tubercles, which they cause to appear almost like small fascicles, and they are comparatively short there, as also on the prothorax and head; but on the muzzle, legs (femora as well as tibiae), and abdomen they are rather dense and decidedly long (almost hair-like). The rostrum is very peculiar, the median carina is entirely absent, the intermediate ones are short and much closer together than usual; the sublateral sulcus on each side becomes a wide excavation (at its widest fully half the distance between the eyes), bounded behind (but not closed by same), by an obtuse elevation (but this could not be regarded as a tubercle), and open in front, where the intermediate carina vanishes; the scrobes are deep in front and at the middle, and are then directed towards the lower half of the eyes, but vanish before reaching them. The scape is moderately long and somewhat thickened at the apex, all the other joints (except the basal one of the funicle) are missing from the type. The elytral tubercles are all small, but a few about summit of apical slope are fairly conspicuous; they mostly have the appearance as of being flattened backwards. A specimen recently taken by Mr. R. Baxter is in perfect condition, and is so densely clothed that the derm is almost everywhere concealed; its prothorax is slightly wider than long, and antennae somewhat longer than usual. Type, K. 15050, in Australian Museum.

Howeocis, n. g.

Head moderately large, almost concealed from above. Eyes small, lateral, coarsely faceted. Rostrum rather short; scrobes narrow and deep, front portion visible from above, posteriorly obliquely directed towards and reaching front margin of eyes. Antennae thin; scape lightly curved; basal joint of funicle elongate, the others short; club briefly ovate. Prothorax lightly transverse, ocular lobes almost absent. Scutellum absent. Elytra subovate, seriate-punctate. Prosternum feebly incurved to middle at apex. Metasternum short. Abdomen with two basal segments large, intercoxal process very wide, third and fourth very short, the fifth small. Legs moderately long; front coxae touching, middle pair lightly separated, hind pair about as far apart as the femora are long; femora moderately stout; tibiae long and rather thin, dilated at apex; tarsi thin, third joint moderately wide and deeply bilobed, claw joint thin, as long as the rest combined, with free claws.

The only known species is a small, conspicuously setose weevil, with some parts densely clothed, but the abdomen and sides of elytra highly polished. The narrow deep scrobes, clearly cutting into the rostrum to the front of the eyes, are practically the only features distinguishing it from *Mandalotus* (near which it should be placed in catalogues), although on account of several of its specific features it would appear out of place in that genus. Three specimens were obtained from fallen leaves; I have not broken one of them to be certain, but believe the body to be apterous.

Howeocis setosus, n. sp.

Black, appendages and apical segment of abdomen reddish. Densely clothed with muddy-brown scales, but sides of elytra for the space of about three interstices, and abdomen, highly polished and with a feeble bluish gloss; with numerous long, stiff, upright setae on prothorax and elytra, and a few between eyes.

Head with sculpture normally concealed. Rostrum with apical portion polished but scarcely in the form of a triangular plate. Prothorax with rather strongly rounded sides; with dense small punctures, and some of larger size, but all more or less concealed before abrasion. Elytra with sides rather strongly rounded, widest at about basal third; with regular rows of large, rounded punctures, partially concealed by clothing except on sides, where they are very conspicuous, although somewhat smaller. First segment of abdomen about as long as second and third combined, fifth as long as third and fourth combined. Length, 2·5-3 mm.

Hab.—Lord Howe Island (A. M. Lea and wife). Type, I. 5801.

A small dingy weevil, but of exceptional interest.

Laemosaccus brevipennis, Pasc.

The type of this species was a female. The male differs in having the rostrum slightly shorter, wider, opaque, and rough throughout, with subgranular elevations. The median fascia of the elytra is composed of short dark velvety pile, margined with ochreous, and is usually very distinct, but is occasionally broken up into irregular spots. The eyes are unusually widely separated, their distance apart being about equal to the diameter of an eye. The species occurs from the Manning River, in New South Wales, to Cairns, in Queensland.

Laemosaccus rivularis, Lea.

This species is not a variety of *L. bilobus*, as I thought possible when describing it; but its type is an immature female. Six specimens from Queensland (National Park, and Bunya and Tambourine Mountains) are evidently mature, and in perfect condition. The general colour is piceous-brown or black, the elytra obscurely paler, the prothoracic spots are as described on the type; on each elytron there are numerous small spots; one on the third interstice at base, several forming an oblique row commencing at the scutellum, the row becoming irregular till it joins an irregular postmedian fascia of spots, a spot common to the second and third interstices at apex, and one on the eighth about middle. The male differs from the female in having the rostrum shorter, stouter, opaque, with coarser punctures, and a well-defined median groove to near the apex.

Laemosaccus argenteus, Lea.

The type of this species is a female. The male differs in having the rostrum much shorter, stouter, opaque, and with decidedly coarser punctures (almost as coarse as those on pronotum). The length (excluding rostrum) varies from 2·5 mm to 4·5 mm. Queensland specimens now before me are from Kuranda, Brisbane, and Bribie Island. The specimen from the island has reddish legs and is probably immature.

Laemosaccus haustellatus, n. sp.

♂. Black or blackish, antennae and legs more or less reddish. Upper surface with yellowish pubescence, becoming whitish on under surface.

Head long and with crowded punctures. Eyes large and almost touching. Rostrum long (about the length of front tibiae), slightly curved, fairly wide in front, narrowed between insertion of antennae (almost in exact middle) and

base; with a small inter-antennal fovea, and with rather crowded punctures. Prothorax with the median length slightly more than the greatest width, apex about two-thirds the width of base; with crowded punctures, slightly larger than on head. Elytra with narrow striae, containing deep-set punctures; interstices granulate and densely punctate. Femora dentate. Length (excluding rostrum), 5-6·5 mm.

♀. Differs in having the rostrum much longer and thinner, with smaller and sparser punctures, and antennae inserted distinctly nearer the base, the elytra are slightly wider, and legs and club of antennae somewhat shorter.

Hab.—Northern Territory (J. P. Tepper), Darwin (C. Davies), Mary River (G. F. Hill). North-Western Australia: Wyndham (J. Clark). Type, I. 16014.

Allied to *L. longiceps*, and with the eyes almost touching as in that species, but rougher, rostrum of female slightly longer, and femoral dentition much less distinct; *L. dapsilis* and *L. ocularis* have eyes less close together, and the rostrum of the female wider, and with coarser punctures. As on many other species, the prothoracic clothing forms a more or less distinct cross. Of the eight specimens before me five are coloured as described, except that on two of them the femora are deeply infuscated; on two others the elytra are obscurely reddish at the tips, and along part of the suture; the other is entirely of a dingy red. The yellowish pubescence forms a narrow line between the eyes, beyond which it is continued (but wider) to the base of the head; on the pronotum it forms a median line, but is dilated to and interrupted at middle, with a small spot on each side of the interruption (on some specimens, owing to partial abrasion, there appear to be four submedian spots), the front and hind angles appear to be spotted from above, but the spots are joined to the lateral clothing. On the elytra the pubescence is dense on the basal half of the sutural region, and four more or less feeble fasciae may be traced: one basal (usually feeble), another before the middle (connected with the dense sutural patch), the third postmedian (on some specimens appearing as a double transverse row of spots), and the other apical (this usually feeble). The front femora have a small but acute tooth, becoming smaller on the middle pair, and almost vanishing from the hind ones.

Laemosaccus bidentatus, n. sp.

♂. Black, antennae and legs more or less reddish. With whitish and pale yellowish pubescence.

Head long. Eyes large and almost touching. Rostrum rather long (slightly shorter than front tibiae), slightly curved, slightly dilated in front of antennae (these inserted about one-third from apex), and with rather coarse crowded punctures. Prothorax slightly longer than wide, with the remnant of a median line in front. Front legs long, their femora conspicuously bidentate. Length, 5 mm.

Hab.—Queensland: Endeavour River (C. French).

The eyes are as close together as on the preceding species and on *L. longiceps*, but from those species, as also from *L. dapsilis*, it is readily distinguished by the bidentate front femora; the largest tooth is subbasal, acute, and about as long as the tibiae are wide, the other tooth is close to it, about half its size and less acute. The type is possibly somewhat abraded, as there is no clothing on the upper surface of its head and on the pronotum (except on the angles and middle of the base of the latter); on the elytra there is a fairly large X-shaped patch on the basal half of the sutural region, an interrupted fascia at the apex, and small spots elsewhere. The punctures and elytral granules are normal. A specimen, from Cairns (J. A. Anderson), is in the Queensland

Museum; it agrees closely with the type, except that it has somewhat darker antennae.

Laemosaccus subcylindricus, n. sp.

♂. Dull red; head, extreme base of rostrum, scutellum, and most of under surface black. Moderately clothed with white or stramineous pubescence, forming spots on elytra, and becoming dense on sides of prothorax, and on under surface.

Eyes large and fairly close together. Rostrum moderately long (slightly shorter than front tibiae), feebly dilated to apex, very feebly curved; with a feeble median line; punctures fairly coarse and crowded, but mostly concealed behind insertion of antennae (about one-third from apex). Prothorax with median length almost equal to greatest width, apex about one-third less than base and feebly bisinuate, with a vague median line, containing a feeble and abbreviated carina; densely and minutely granulate-punctate. Elytra rather long and subcylindrical, slightly wider than prothorax; with deep-set punctures in narrow striae, interstices densely punctate or granulate-punctate. Front femora strongly, middle moderately, hind ones feebly dentate. Length, 4·5-5 mm.

♀. Differs in having the rostrum slightly longer and thinner, more cylindrical, with sparser clothing and smaller punctures; antennae inserted nearer the middle of rostrum, and front legs slightly smaller.

Hab.—Victoria (National Museum), Kewell (— Hill). Type, I. 16032.

In general appearance close to *L. cossonoides*, but eyes closer together and clothing of upper surface more concentrated into spots, these forming a loose fascia just beyond the middle of elytra. *L. ocularis* is larger, has rostrum longer and more curved, fascia of elytral spots nearer the apex, the basal clothing different, and femora edentate. On the upper surface the pubescence is sparsely but evenly distributed, except that it is fairly dense behind the scutellum, forms a transverse series of spots beyond the middle (they appear to be always present on the second and third interstices and usually on the fifth and sixth, but the latter are easily abraded), and a feeble fascia at apex; on the pronotum it forms a rather wide median line, which is dilated, and sometimes maculate, about the middle; on the head it is dense between the eyes and on the sides; on the male it is continued to the middle of the rostrum, but not so far on the female. The distance between the eyes, at their nearest approach to each other, is about half the width of the rostrum in the female, somewhat less in the male. The elytral granules are minute and rounded, without the jagged appearance as on most species of the genus.

Laemosaccus marmoratus, n. sp.

Dull red and blackish-brown. With more or less yellowish or ochreous pubescence.

Eyes large and rather widely separated. Rostrum slightly longer than front tibiae, rather thin, straight and cylindrical; with crowded and well-defined punctures; with a feeble median carina behind antennae (these inserted about two-thirds from base). Prothorax slightly wider than long, with a feeble median carina on basal half, on each side of which at base is a feeble elliptic depression or fovea. Elytra short, depressed in middle towards base; with narrow punctures, in deep striae. Front femora stout and acutely dentate, the others smaller. Length, 4·5 mm.

Hab.—New South Wales. Unique.

The upper surface has a mottled appearance, somewhat as on many specimens of *L. subsignatus*, but the pubescence forms a conspicuous V on the elytra. The rostrum is long, straight, and clothed only at the extreme base, but as it is subopaque and rather coarsely punctured, the type is possibly a male. The

head and rostrum are blackish, as is most of the pronotum, on the elytra there are five or seven dark patches, most of the abdomen is black, the rest of the under surface and the legs are reddish. On the pronotum the pubescence is dense on the sides, and forms a median line with a cross-piece at the basal third; on the elytra the sides of the V commence on the shoulders and are conjoined on the suture near the apex. The distance between the eyes, at their nearest approach, is about half the width of the rostrum. The punctures on the head and prothorax are crowded and small, the elytral interstices are densely granulate-punctate, the granules round and inconspicuous, but there are a few coarse ones about the apical third. The sutural interstice on each elytron is terminated at the scutellum (which is twice as wide as long), the base of the second is slightly curved around it.

Laemosaccus tenuirostris, n. sp.

♀. Black, antennae, front of prothorax, most of elytra, tarsi, and parts of tibiae reddish. Irregularly clothed with somewhat yellowish pubescence.

Eyes large and well separated. Rostrum long, thin, straight, and cylindrical; with dense and moderately large punctures towards base, becoming small and sparser towards apex. Antennae inserted about two-fifths from base of rostrum. Prothorax slightly longer than wide, rather strongly constricted near apex; with a feeble median line in front, altering to a carina towards base; with two well-defined foveae at base, and two feeble impressions in middle. Elytra strongly depressed about suture near base. Femora acutely dentate. Length, 5 mm.

Hab.—Queensland: Mount Tambourine (H. J. Carter). Type, I. 16015.

The elytral markings simulate those of pale specimens of *L. querulus*, *L. subsignatus*, etc., but the rostrum is much longer than in those species, and is decidedly longer than in any species in which it is straight; it is distinctly longer than the front tibiae and is quite as long as in *L. longiceps*, in which it is curved. The type differs from that of the preceding species in having a much longer rostrum (it is, however, certain to be sexually variable), the prothoracic foveae more conspicuous, elytra without a pubescent V, the dark markings differently disposed, most of the legs, and all of the under surface black. The punctures and the elytral granules are much the same. From above the elytra appear to have five black spots; a round mediosutural one, and two on each side, of which the first is triangular and before the middle, the other beyond the middle and transverse, but the lateral spots are joined on the margins. The clothing is probably partly abraded, the pubescence is rather dense on the sides of the prothorax and forms a cross in the middle (the cross-piece nearer base than apex; on the elytra it is pale on the red parts, and blackish on the dark parts. The distance between the eyes is slightly more than half the width of the rostrum. At a glance the front femora appear to be bidentate, but this is due to the unusual prominence of the trochanters.

Laemosaccus cylindricus, n. sp.

Black, antennae, tarsi, tibiae, and parts of femora reddish. Irregularly clothed with golden pubescence, becoming whitish on under surface.

Eyes large and close together. Rostrum long (slightly longer than front tibiae), thin, cylindrical, shining, and feebly curved; with dense and fairly coarse punctures about base, becoming smaller and sparser in front. Antennae inserted about two-fifths from base of rostrum. Prothorax slightly longer than wide, sides feebly rounded, slightly constricted near apex, which is not much narrower than base, median line feeble; with small crowded punctures. Elytra long, cylindrical, scarcely wider than widest part of prothorax; striate-punctate, interstices with small crowded punctures, the fifth with a few granules. Femora feebly dentate. Length, 2·5-3 mm.

Hab.—Victoria: Dividing Range (Rev. T. Blackburn). Type, I. 16016.

A narrow cylindrical species, with outlines approaching those of *Magdalis*. In general appearance it is close to *L. festivus,* but is longer and thinner, the rostrum is decidedly longer and thinner, and is not straight; as it is alike on six specimens, taken by Mr. Blackburn, they are probably all females. The golden pubescence is dense on the sides of the prothorax, and irregular about the middle, on the elytra it is fairly dense in the sutural region, and about apex, just beyond the middle it has a subfasciate appearance, owing to fine lines on most of the interstices. The distance between the eyes is less than one-third the width of the rostrum.

Laemosaccus biseriatus, n. sp.

Black, antennae and tarsi reddish. Rather sparsely clothed with short, rusty, or golden-red pubescence, the elytra with two transverse series of golden spots.

Eyes large, round, and moderately separated. Rostrum slightly longer than front tibiae, and slightly shorter than prothorax, subcylindrical, moderately curved; with rather coarse crowded punctures about base, smaller and sparser, but sharply defined elsewhere. Antennae inserted in middle of rostrum. Prothorax moderately transverse, sides gently rounded, and constricted near apex, which is feebly trisinuate; a feeble remnant of a median carina in middle; punctures crowded and small. Scutellum small and round. Elytra rather long and cylindrical, scarcely wider than widest part of prothorax; striate-punctate, interstices densely punctate and gently ridged along middle; without distinct granules. Front femora acutely dentate, the others less distinctly so. Length, 4·5 mm.

Hab.—Victoria: Dividing Range (Rev. T. Blackburn). Type, I. 16017.

A cylindrical species, with outlines approaching those of *Magdalis;* no closely allied one has previously been named from Australia. The type is thinly clothed with short depressed pubescence, usually inconspicuous, but from some directions it appears of a beautiful golden-red; the golden spots on the elytra are in two series, one at the basal third on the second to fourth interstices, the other at the apical third on the second to sixth interstices, but on the second series the spots on the third and fourth interstices are posterior to the others. The distance between the eyes is about one-third the width of the base of the rostrum. The type is probably a female, but was described, as its clothing is evidently in perfect condition; two somewhat smaller specimens (3·5-4 mm.) are probably partly abraded males of the species, their pubescence is as on the type, but is sparser, and on the elytra the series at the apical third is very feeble and no trace remains of the series at the basal third; they have the rostrum somewhat shorter (although longer than the front tibiae) and wider, but with similar punctures, and with the eyes slightly closer together.

Laemosaccus imitator, n. sp.

Black, elytra almost black, antennae (club darker) and legs more or less reddish. Sparsely clothed with depressed, inconspicuous pubescence.

Eyes large and round but widely separated. Rostrum moderately wide, slightly longer than front tibiae, distinctly curved and shining; with rather dense and coarse punctures at base, becoming smaller in front; with a shining impunctate line from base to antennae (which are inserted just perceptibly beyond the middle), where it terminates at a feeble longitudinal impression. Prothorax with outlines, punctures, and remnant of a carina as in the preceding species. Scutellum small and round. Elytra subcylindrical, scarcely wider than prothorax. Femora each with a small acute tooth. Length, 3 mm.

Hab.—South Australia: Port Lincoln (Rev. T. Blackburn). Type, I. 16024.

A *Magdalis*-like species, with curved rostrum, and widely separated eyes, the

distance between them almost equal to the width of an eye. The outlines are somewhat as in the preceding species, from which it differs in having shorter elytra, with sparser clothing, wider rostrum and more distant eyes; the seriate punctures on the elytra are much the same, but the interstices are less convex, and have sparser punctures. *L. magdaloides* is a smaller species, with eyes much closer together. The type, which is probably a male, has the general appearance of *Magdalis stenotarsus*, but the club is much shorter, and the third tarsal joint is wider.

Laemosaccus quadriseriatus, n. sp.

Black, antennae pale reddish, the club and tarsi darker. Upper surface with ochreous spots and markings.

Eyes large, round, and well separated. Rostrum moderately long (slightly longer than the front tibiae), feebly curved, not very wide, sides slightly incurved to middle; with crowded and moderately large punctures at base, becoming smaller but still dense in front. Antennae inserted slightly nearer base than apex of rostrum. Prothorax about as long as wide, sides rather strongly rounded, median carina feeble but traceable on basal half. Elytra slightly wider than widest part of prothorax. Front femora acutely, the others more feebly dentate. Length, 4·5 mm.

Hab.—Tasmania: Cradle Mountain (H. J. Carter and A. M. Lea). Type (unique), I. 16018.

The prothoracic outlines and punctures, and the elytral striae, punctures and granules, are as on most species of the genus; but the markings should be distinctive, they are: a median line on the head from base to base of rostrum, a fairly large spot in middle of apex of pronotum, a longer one at base, and two small spots in middle (remnants of a cross), and some feeble spots at sides; on the elytra the spots form four distinct transverse series, one at the base of rather long spots on the third and fifth interstices, with one on the margin (invisible from above); the second before the middle, on the first and second interstices; the third beyond the middle, on the second to fourth and sixth to eighth interstices; and one on the third interstice at apex. The distance between the eyes, at their nearest, is about half the width of the base of rostrum.

Laemosaccus niveonotatus, n. sp.

♂. Dark brown, antennae paler, parts of under surface black or blackish. Clothed with white and ochreous pubescence.

Eyes large, round, and well separated. Rostrum not very long (slightly shorter than front tibiae), feebly curved and rather stout; with dense and coarse punctures, somewhat smaller and sharply defined in front, but still dense; with a short median line. Antennae inserted about one-third from apex, in scrobes, parts of which are distinct from above. Prothorax slightly narrower than the median length, with a feeble median line, becoming feebly carinate at base, on each side of which is a feeble depression or fovea. Elytra depressed behind scutellum (which is within a conspicuous depression); the interstices with numerous small, flat, shining granules, but with many larger angular ones on apical third. Femora, especially the front ones, strongly and acutely dentate. Length, 5-6 mm.

♀. Differs in having the rostrum smoother, subcylindrical, clothed only at extreme base, with smaller and more sharply defined punctures, nowhere confluent, and clothed only at extreme base; the front legs are also shorter.

Hab.—Queensland: Dalby (Mrs. F. H. Hobler).

Allied to *L. tropicus* and *L. rivularis,* from the former distinguished by the more numerous spots on elytra, and absence of a large patch of pubescence about

the scutellum; from the latter by the absence of an oblique row of spots on each elytron commencing at the scutellum (the two forming sides of a wide angle). The white pubescence is dense on the under surface, including sides of prothorax, but there are five ochreous spots on each side: two on the prosternum, two on the metasternum, and one at base of abdomen, but they are not sharply limited. On the elytra it is rather sparse about the base, and is condensed into numerous small spots in three posteriorly curved series, of these the first is at the basal third, on the first to fourth interstices (on two specimens present only on the second and third), the second is beyond the middle, irregularly extending from the suture to the margins (but on one specimen represented only by spots on the third and eighth interstices), the third is close to apex (on one specimen it is represented by three spots on each side, on another by one spot on each side, but it is absent from a third specimen); there are also a few irregular spots between the two submedian series on two specimens. The ochreous pubescence is dense on the head between the eyes, and extends well on to the rostrum of the male; on the pronotum it forms a rather feeble cross, the long piece interrupted at the basal third, where two spots represent the cross-piece. The prothoracic punctures, and the elytral punctures and striae, are much as on many other species, but the elytral granules are more numerous and conspicuous.

Laemosaccus triseriatus, n. sp.

Black, front of prothorax, elytra, legs (front ones partly black), and antennae more or less reddish. Clothed with pale ochreous or somewhat golden pubescence, dense on front of head and between the eyes, on the sides of prothorax, on scutellum, and on under surface, forming a cross on pronotum, and three transverse series of spots on elytra.

Eyes large and subelliptic, separated about half of the width of base of rostrum. Rostrum slightly longer than front tibiae, somewhat curved, subcylindrical; with fairly coarse but partially concealed punctures about base, becoming smaller but sharply defined in front. Antennae inserted slightly nearer apex than base of rostrum. Prothorax with a feeble median line in front, and a feeble median carina at base, on each side of the latter a shallow depression. Elytra with dense and minute granules, but becoming numerous and conspicuous beyond the second series of spots, a few on the third and fifth interstices elsewhere. Femora strongly (the front pair very strongly) and acutely dentate. Length, 5·25 mm.

Hab.—Northern Queensland (Blackburn collection). Type (unique), I. 16019.

Allied to *L. rivularis, tropicus, bilobus*, and the preceding species, from all of which it is at once distinguished by the rostrum. On those species on the male it is wider, rougher, and grooved; their females have it shining, glabrous, and with small punctures. The sex of the type is doubtful, but it is probably male; its rostrum is long, slightly curved, subopaque but not rough, clothed from base to insertion of antennae, and its punctures are fairly coarse. The arms of the cross on the pronotum are represented by a spot on each side of the middle at the basal third; on the elytra the first series of spots is just before the basal third, on the second to fourth interstices, the second is somewhat sinuous, beyond the middle on the second to ninth interstices, and the third is near the apex.

Laemosaccus microps, n. sp.

Reddish-castaneous, prothorax and elytra with dark markings. Unevenly clothed with pale ochreous pubescence.

Eyes round, comparatively small, and very widely separated. Rostrum short, wide at the base and rather wide at apex, straight, shallowly grooved along

middle and with dense punctures, sharply defined in front, but more crowded and partially concealed about base. Antennae inserted slightly nearer apex than base of rostrum. Prothorax about as wide as the median length, median line thin and traceable throughout; punctures normal. Elytra striate-punctate, with numerous minute granules, and some larger rough ones beyond the middle, especially on the fifth interstice. Front femora strongly but somewhat obtusely dentate, the others each with a smaller but acute tooth. Length, 4 mm.

Hab.—Queensland: Cairns district (A. M. Lea). Type (unique), I. 16020.

The eyes are unusally wide apart, the distance between them being about equal to twice the diameter of an eye. *L. brevipennis*, which has somewhat similar eyes, is a larger species, with a considerably longer rostrum, prothorax less convex (especially in front), elytra more concave about the suture, and very different clothing. The dark markings on the pronotum are due to rather slight infuscations, which form a distinct circle on each side of the middle at the basal third, the circles connected with other thin infuscations; on the elytra, in addition to some feeble spots, there is a distinct oblique line from each shoulder to near the middle of the fifth interstice. There are three seminude spots on the head. As the rostrum is feebly grooved the type is probably a male.

Laemosaccus latirostris, n. sp.

♂. Black and reddish. Clothed with pubescence varying from whitish to ochreous, and on the elytra forming three transverse series of feebly defined, elongated spots.

Eyes fairly large but widely separated. Rostrum short, wide, and straight, slightly dilated to apex; with coarse punctures. Antennae inserted almost in middle of rostrum. Prothorax distinctly transverse, strongly convex, median carina traceable almost throughout, a distinct fovea on each side of its base; densely granulate-punctate. Elytra short, with a few small granules on fifth interstice, elsewhere inconspicuous. Femora, even the front ones, rather feebly dentate. Length, 2 mm.

Hab.—Queensland: Cairns district (A. M. Lea). Type, I. 16021.

A very small species, with unusually wide rostrum, this, except for the jaws, being quite as wide as long. The elytral markings are suggestive of unusually small and pale specimens of *L. subsignatus* and *L. querulus*, but the smallest specimens of those species before me are considerably larger than the largest one of the present; the eyes are also more widely separated (the distance between them is slightly more than the diameter of an eye). The four males taken vary in intensity of the colours. The prothorax is black or blackish, with the apex reddish; on the elytra there is a curved blackish mark from each shoulder to about the middle of the fifth interstice (sometimes represented by spots), and an irregular subapical fascia (on one specimen appearing as five isolated spots); the under surface is mostly blackish, the front femora (or all of them) and parts of the head are infuscated. The inner margins of the eyes are accentuated by strips of pale pubescence.

Laemosaccus scutellaris, n. sp.

Black; prothorax, elytra, and antennae, except club, reddish. Sparsely pubescent.

Eyes large and rather close together. Rostrum about the length of front tibiae, straight, cylindrical, and highly polished; with sparse and minute punctures. Antennae inserted about basal third of rostrum. Prothorax slightly longer than wide, median line traceable throughout; densely granulate-punctate. Scutellum equilaterally triangular. Elytra moderately long and subcylindrical; narrowly striate-punctate, interstices with very fine granules and some of larger size, but

none rough and conspicuous. Front femora moderately, the others feebly dentate. Length, 4·5 mm.

Hab.—New South Wales: Jindabyne (H. J. Carter). Unique.

A red and deep-black species, with a short, straight, cylindrical rostrum, readily distinguished from all other species with red elytra by the comparatively large and conspicuously triangular scutellum. The elytra, at the apical third, have a transverse series of thin spots of stramineous pubescence, fairly distinct on the second to fourth interstices, and traceable on others, the scutellar region is slightly pubescent; the pronotum is glabrous, except about the base and apex, which are very feebly clothed.

Laemosaccus cylindrirostris, n. sp.

Black and reddish. A strip of pale pubescence along the inner side of each eye, elsewhere very feebly pubescent.

Eyes large and separated almost the width of that of rostrum. Rostrum rather short, thin, straight, cylindrical, and shining; with sparse and minute punctures, becoming larger at base. Antennae inserted at base of rostrum. Prothorax slightly wider than long, strongly convex, sides strongly rounded, base much wider than apex; with a narrow median carina distinct from base to apex; punctures crowded and rather coarse. Elytra rather long, parallel-sided except at base and apex; strongly striate-punctate; interstices without distinct granules. Front femora acutely dentate near base, the others feebly dentate. Length, 2·5-3 mm.

Hab.—South Australia: Quorn (Rev. T. Blackburn), Morgan (A. M. Lea). Type, I. 16022.

A small variable species, distinct from most of the genus by the continuous carina of pronotum and insertion of antennae. Two specimens have elytra coloured as on *L. rufipennis,* but that species has no carina on the pronotum and its rostrum is stouter; *L. instabilis* has similar rostrum and insertion of antennae, but is more coarsely sculptured, and has a groove instead of a carina on the pronotum; *L. rufipes,* with a similar rostrum, has the pronotum bifoveate; *L. variabilis* and *L. melanocephalus* have the rostrum curved. The black parts of the type are the head, prothorax (except for a fairly wide vitta on each side), scutellum, sides and apex of elytra (rather widely), under surface, coxae and parts of hind femora. A second specimen has a large black spot in the middle of the pronotum (touching the base but not the apex), sides of the elytra but not the tips, black, and the hind legs entirely reddish, the rest as on the type. A third specimen has the pronotum and elytra entirely pale (its hind and middle legs are missing). They are probably all females.

Laemosaccus nigrirostris, n. sp.

Black; prothorax, elytra, antennae (the club more or less infuscated), and legs (the femora sometimes excepted) reddish. Sparsely pubescent, but with a transverse series of feeble pale spots, at the apical third of elytra.

Eyes large and separated about half the width of base of rostrum. Rostrum short, rather stout, cylindrical, straight and shining; with sparse and minute punctures, but larger ones at base. Antennae inserted about one-third from base of rostrum. Prothorax rather strongly convex, about as wide as long, sides rather strongly rounded; with a short and feeble carina in middle, ending in front in a shallow median line; densely granulate-punctate. Elytra subcylindrical, the width of prothorax at its widest; strongly striate-punctate, interstices with dense punctures, and a few granules. Front femora rather feebly dentate near base, the others still more feebly. Length, 2·75-4 mm.

Hab.—Victoria: Sea Lake (J. C. Goudie, No. 600). South Australia: Leigh Creek (Rev. T. Blackburn), Mount Lofty Ranges. Type, I. 16023.

Structurally close to *L. rufipennis* and *L. ater,* and with a similar rostrum, but the ten specimens examined have the elytra uniformly coloured, except that on two from Mount Lofty Ranges, the ninth interstice is feebly infuscated about its middle; on all the specimens I have seen of *L. rufipennis* the sides and apex of elytra, and most of the prothorax and legs are black; on *L. ater* all parts are black, except the antennae and parts of the legs and the clothing. *L. melanocephalus, L. ventralis,* and some specimens of *L. variabilis* are somewhat similarly coloured, but have the rostrum curved. The rostrum is stouter than in the preceding species, and black or blackish, with the antennae inserted less close to the base. There are a few distinct granules on the fifth interstice beyond the middle, and usually one or two on the fourth and sixth; but the specimens from Leigh Creek are without any, although they are not otherwise aberrant.

Laemosaccus pubicollis, n. sp.

♀. Black; apex of prothorax, elytra (except extreme base), antennae (the club somewhat infuscated) and legs reddish. In places rather densely clothed with stramineous pubescence.

Eyes large and close together in front. Rostrum rather long (slightly shorter than prothorax and distinctly longer than front tibiae), slightly curved, and subcylindrical; with numerous sharply defined but rather small punctures, becoming larger and more crowded towards base; with a thin shining median line from near base to near apex. Antennae inserted just perceptibly nearer base than apex of rostrum. Prothorax slightly transverse; with a short, shining, median carina; with crowded partially concealed punctures. Elytra with normal punctures, striae and granules. Front femora moderately, the others very feebly dentate. Length, 4 mm.

Hab.—Victoria (C. French). Unique.

To a certain extent resembles *L. carinicollis,* but the rostrum is somewhat shorter and less curved, and the eyes are closer together. The pubescence is dense on the front parts of the head (it appears as a very narrow line between the eyes), on the pronotum (on which no cross is indicated, although the median carina is very conspicuous), covers a large subtriangular space at the base of the elytra, and forms a fascia of elongated spots at the apical third; the apex and sides are rather sparsely clothed. The third tarsal joint is wider, with the claw joint less produced than is usual.

Laemosaccus rufirostris, n. sp.

Reddish; head, scutellum, and parts of under surface black. Moderately clothed with pale ochreous pubescence, becoming stramineous on head and under surface.

Eyes large, separated about one-third of the width of rostrum. Rostrum almost straight, the length of prothorax, and distinctly longer than front tibiae, sides very feebly incurved to middle; with sharply defined but not very large or crowded punctures. Antennae inserted about two-fifths from base of rostrum. Prothorax about as wide as the median length, sides feebly rounded but rather suddenly narrowed at apex; with a shining median carina, almost traceable to base, but terminated some distance from apex; densely granulate-punctate. Elytra moderately long, not much wider than prothorax; striate-punctate, interstices densely punctate, the fifth and sixth with a few large granules. Femora almost edentate. Length, 3·75 mm.

Hab.—Western Australia: Pinjarrah (A. M. Lea). Unique.

Readily distinguished from *L. carinicollis,* apart from colour, by the almost straight rostrum. It is close to the preceding species, from which it differs in the red rostrum, more dilated at apex (this may be sexual), eyes slightly more apart, pronotum entirely pale and with the usual cross-shaped pubescence, and third tarsal joint less dilated. The clothing is fairly dense on the front of the head, on the sides and apex of prothorax, and forms a cross on its middle; on the elytra it is fairly dense on some of the interstices about base, forms long strips on most of them in a transverse series beyond the middle, and is moderately dense on the tips.

Laemosaccus semicrudus, n. sp.

♂. Head, base of rostrum, scutellum, and under surface black, elsewhere reddish. Sparsely pubescent.

Eyes large and moderately separated. Rostrum short, stout, straight, and with fairly coarse punctures about base. Antennae inserted near base of rostrum. Prothorax slightly transverse, with a continuous median line, a small fovea on each side of its base; with crowded punctures. Elytra parallel-sided except at base and apex, slightly wider than prothorax; striate-punctate; interstices with crowded punctures, and a few rather inconspicuous granules. Front femora rather feebly dentate, the others still more feebly. Length, 2 mm.

Hab.—Western Australia: Swan River (A. M. Lea).

A female is represented by a head and prothorax, with their appendages; its rostrum differs from that of the male in being thin, cylindrical, and highly polished. The species is near *L. instabilis,* but the sculpture is not quite as coarse, the basal foveae of the pronotum are smaller, and no median ones are traceable (they are sometimes feeble on that species); I have seen no specimen of *instabilis* with entirely pale elytra. The distance between the eyes is about half the width of the rostrum.

Laemosaccus calotrichus, n. sp.

♂. Black and reddish. Irregularly clothed with white and golden pubescence.

Eyes large and round, their distance apart less than half their diameter. Rostrum short and stout; with a shallow median groove, opening in front to a space where the surface is shining, and with sharply defined punctures. Antennae inserted slightly nearer apex than base of rostrum. Prothorax about as long as wide, sides evenly rounded; with a feeble median line slightly elevated at base and apex, with a conspicuous fovea on each side of the middle of base, and a small one on each side of middle (the latter usually containing a spot of golden pubescence). Elytra distinctly wider than prothorax. Femora acutely dentate. Length, 4-5·5 mm.

♀. Differs in having the rostrum longer, thinner, smoother, and shining, with the punctures less crowded and more sharply defined.

Hab.—Queensland: National Park (H. Hacker). Type in Queensland Museum; cotype, I. 16112, in South Australian Museum.

A beautiful species, allied to *L. tropicus, rivularis,* and *niveonotatus,* but readily distinguished by the markings. Regarding red as the ground colour the black (or deeply infuscated) parts are the back part of the head, muzzle, a triangular space on pronotum (narrow at apex and dilated—but with incurved sides—till it occupies almost the entire base), sides and apical fourth of elytra (but not the extreme tips), most of under surface, pygidium, and front femora. The white pubescence is dense on most of the under surface, forms a large basal patch on the elytra extending to the third (inclusive) interstice on each, and to

about the middle of their length, with a short extension on each corner of the patch; many spots form an interrupted fascia at the apical third, and there are some at the apex itself; on the pronotum there is a long spot between the basal foveae. The golden pubescence is fairly dense in the front of the pronotum, and between and adjacent to the eyes. The pubescence, however, appears to be easily abraded. The punctures of the upper surface and the striae and granules of the elytra are as on many other species.

ANTHRIBIDAE.

There are before me five beautiful species of this family, scarlet with black markings, or blackish and scarlet. In Blackburn's table of the family [6] they could either be referred to *Epargemus* or to new genera. In all of them the scrobe is turned obliquely under the rostrum, but in addition to the true scrobe there is a shallow depression on each side, that is directed below the lower edge of the eye. In two of them the rostrum is very wide at the base, being there but little narrower than the head, and it is feebly dilated to just before the jaws; their colours are very different from those of the typical species of *Epargemus*, but I provisionally refer them to that genus. In the three others the rostrum is decidedly narrower at the base than the head, and is noticeably inflated in front, for these a new genus is proposed.

Epargemus crucifer, n. sp.

Black, elytra scarlet with a black cross; parts of muzzle, basal joint of antennae, front of prothorax, abdomen, and metasternum reddish, parts of legs obscurely reddish. Rather sparsely clothed with golden or whitish pubescence, nowhere forming fascicles.

Head wide, densely longitudinally strigose and with a few punctures. Eyes elliptic, the length of two basal joints of antennae. Rostrum wide and flat, at base scarcely narrower than base of head, slightly dilated in front, where it is slightly wider than long (excluding the mandibles); with crowded punctures in front, becoming strigose at base; with a thin median carina. Antennae with base concealed by edge of rostrum, first joint slightly longer than second, but apparently shorter, the others gradually decreasing in length to eighth, ninth to eleventh dilated, and forming a conspicuous club. Prothorax slightly transverse, sides gently undulated to base, which is distinctly wider than apex; with a strong carina, rather close to base in middle, sinuous and produced forwards on sides to near the middle; with crowded and rather coarse punctures, suddenly becoming much finer about apex. Elytra not much wider than prothorax, about one-fourth wider than long; with rows of large punctures in feeble striae, the interstices with minute punctures. Under surface with rather coarse, irregularly distributed punctures, and with some minute ones; basal segment of abdomen with two small tubercles close together at middle of apex, and two much smaller ones similarly placed on second; apical segment with a small elliptic fovea. Length (excluding rostrum), 4 mm.

Hab.—Queensland: Mount Chalmers (C. French). Unique.

The upright part of the cross extends to the first stria on each elytron for part of its length, about the base it is slightly dilated, but near the apex (which it does not reach) it is suddenly dilated to cover four interstices on each elytron; the transverse part is submedian, near the suture it is about one-fourth the length of the elytra, but is dilated to each side so as to extend to about one-fourth their length.

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(6) Blackb., Trans. Roy. Soc. S. Austr., 1900, p. 142.

Epargemus bicolor, n. sp.

Blackish-brown; front of prothorax, elytra (some blackish markings excepted), metasternum, and abdomen more or less scarlet. Sparsely pubescent.

Head wide, densely longitudinally strigose. Rostrum much as in preceding species, except that the surface is rather more coarsely sculptured. Prothorax slightly transverse, wider at base than at apex, with a strong carina fairly close to base in middle, diverging to the sides, where it is abruptly terminated; with crowded and rather coarse punctures, suddenly becoming much smaller in front. Elytra not much wider than prothorax, about once and one-half as long as wide; with rows of large punctures, wider than interstices, but becoming smaller posteriorly. Under surface with large and small, irregularly distributed punctures; basal segment of abdomen slightly notched in middle of apex; apical segment with a conspicuous fovea, shallowly connected with each side. Length, 3 mm.

Hab.—Queensland: Gayndah (G. Masters).

The type has now lost the clubs of its antennae, but these when examined were similar to those of the preceding species; from that species it is distinct by its smaller size and incomplete cross. Parts of the muzzle and legs, and the two basal joints of antennae are obscurely reddish; on the elytra the suture is slightly infuscated, the infuscation near the apex having a cross-piece that extends across four interstices on each; on each side, about the middle, there is a transverse black mark, beginning at the second stria, and dilated to each side so as to cover about one-fourth of the length. From directly above or below, each end of the prothoracic carina appears as a subtriangular tubercle.

Allochromicis, n. g.

Rostrum much longer than wide, base much narrower than head, sides strongly dilated in front. Other characters as in *Epargemus*. Type of genus, *A. coccineus*.

A genus of three beautiful species that may be distinguished as follows:—

Apical joints of antennae black .. .. *bifasciatus*
Two apical joints of antennae pale.
  Prothorax with four black spots .. .. *picticornis*
  Prothorax without black spots .. .. *coccineus*

Allochromicis coccineus, n. sp.

Scarlet, third to ninth joints of antennae black, two apical ones reddish-white, elytra with a faint spot near the scutellum, and four brownish ones across middle. Rather densely clothed with golden-red pubescence, variegated with small white spots; the under surface more sparingly clothed.

Head moderately convex, densely longitudinally strigose, but surface partially concealed. Eyes large and elliptic. Rostrum (excluding jaws) almost twice as long as the basal width, between antennae fully once and one-half the width of base; with a distinct median carina from base to apex, and a thinner one on each side from base to about the middle; with crowded and partially confluent punctures. Antennae with base concealed by sides of rostrum, first joint apparently shorter than second, but really longer, third slightly longer than second and fourth, sixth to eighth transverse, ninth to eleventh forming a loose club. Prothorax about as long as the greatest width (near base), subbasal carina strong, fairly close to base in middle, more distant on sides; with a shining median line from carina to about middle; with rather coarse and crowded, but partially concealed punctures, suddenly becoming smaller in front. Elytra slightly wider than prothorax, with a shallow impression across basal third; with rows of large punctures in feeble striae, the interstices with dense and minute punctures. Under surface

with minute punctures, and with a few large ones scattered about, but becoming numerous on prosternum, and between the eyes. Length, 4-5 mm.

Hab.—Queensland: Kuranda (F. P. Dodd). Type, I. 16008.

The club is loosely articulated, and subcontinuous with the preceding joints. The submedian spots on the elytra vary in size and intensity, the inner one is almost in the exact middle of each elytron, the outer one is slightly nearer the base. The abdomen on the four specimens under examination is non-foveate.

Allochromicis picticornis, n. sp.

Scarlet; prothorax with four, the elytra with seven black spots; second to ninth joints of antennae black, the two apical ones creamy-white. Rather densely clothed with golden or golden-red pubescence, becoming sparser and paler on under surface. Length, 5-6 mm.

Hab.—New South Wales: Richmond River (type in British Museum). Queensland: National Park, in December (Queensland Museum, from H. Hacker).

The spots are alike on the seven specimens under examination, except that they vary slightly in size and intensity; on the pronotum two round ones are placed in line with the eyes at the apical third, and two at the basal third somewhat more apart, owing to the greater width there; on the elytra one spot is on the suture at about the basal fourth, a transverse one is on the middle of each elytron, extending across two or three interstices, the others are on the sides: a large one at the basal third, the other slightly before the apical third. Structurally close to the preceding species, but larger and more robust, antennae stouter, with the ninth joint much larger, median carina of rostrum not quite extending to apex, shining median line of pronotum replaced by a feeble but longer ridge, which is not shining, and transverse depression on elytra more conspicuous. The abdomen is shallowly depressed along the middle, and the apical segment is conspicuously foveate, but all the specimens may be males.

Allochromicis bifasciatus, n. sp.

Scarlet and blackish-brown, elytra bifasciate. Moderately clothed with pubescence varying from whitish to brown, and in places somewhat golden.

Head and rostrum much as in *A. coccineus,* except that there are fewer punctures between the carinae, and that the median one of these is somewhat shorter. Antennae comparatively thin, second joint slightly longer than third, and apparently (owing to the overlapping of the base) longer than first, the others smaller, ninth to eleventh dilated, and forming a conspicuous club. Prothorax with outlines, carina and punctures much as in *coccineus.* Elytra distinctly wider than prothorax; with rows of large punctures, becoming smaller posteriorly, and not in striae; interstices with small and rather dense punctures. Under surface with numerous minute ones, and some fairly large ones scattered about, and becoming dense on prosternum and apical segment of abdomen. Length, 3-3·5 mm.

Hab.—Queensland: Brisbane (H. J. Carter); West Burleigh (Queensland Museum, from O. W. Tiegs). New South Wales: Sydney (H. W. Brown). Type, I. 16009.

The club, although a rather loose one, is more conspicuously separated from the preceding joints than in the two other species, although owing to the flattening of its joints this is less evident from the sides than from above, where their full width is evident. The elytra are scarlet, with the suture infuscated to the basal fourth, where it joins a complete and rather narrow fascia (which is within a shallow depression), just beyond the middle there is another and somewhat wider fascia, which touches the sides at a less distance from the first than it is at the suture, beyond it the suture is also infuscated; the median part of the suture is

not at all or but feebly infuscated; the metasternum and abdomen are almost as bright as the paler parts of the elytra, the apex of prothorax, parts of the muzzle and legs, and two basal joints of antennae are somewhat reddish. On one of the specimens the pronotum is obscurely reddish, with darker zones near the apex and base; on another specimen the scarlet of the elytra has faded to a reddish-orange. All three specimens have the abdomen non-foveate, and are probably females.

CHRYSOMELIDAE.

Rhyparida microsticta, n. sp.

Flavo-testaceous, under surface somewhat darker, parts of six or seven apical joints of antennae infuscated, elytra with four or six small black spots.

Head subopaque, a short median line connected with the faint clypeal suture; clypeus with distinct but rather sparse punctures, elsewhere without distinct punctures. Eyes prominent and widely separated. Prothorax subopaque and feebly convex; punctures very feeble; front angles acutely armed, the hind ones feebly so. Elytra about one-fourth wider than prothorax; with rows of rather large punctures, becoming smaller (but still quite distinct) posteriorly. Flanks of prosternum smooth and shining. Femora unarmed. Length, 4·5-5 mm.

Hab.—Northern Territory: Groote Eylandt (N. B. Tindale). Type, I. 15553.

Structurally very close to *R. flava,* but elytra with four or six spots (somewhat approaching those of *R. brevilineata,* but the prothorax of that species is very different); on each elytron they are placed as follows: one (about the length of the scutellum) at the basal fourth between the sixth and seventh rows of punctures, one (twice the length of the scutellum or slightly more) between the third and fourth rows (disregarding the short subscutellar row) at the summit of the apical slope, and one, slightly in advance of the second spot, between the seventh and eighth rows; the third spot, however, is not always present. The elytra (except for the spots) are paler than the rest of the upper surface, the knees and tarsi are slightly darker than the rest of the legs. Three specimens were obtained.

Rhyparida rufoparva, n. sp.

Reddish-castaneous, antennae and legs paler.

Head subopaque, a deep median line between eyes; with rather dense and sharply defined punctures on clypeus, smaller but also well-defined about base. Eyes large, the distance between them scarcely one-third the diameter of each. Prothorax subopaque, more than twice as wide as long, flattened in middle, front angles unarmed; punctures larger on sides than in middle, where they are rather small. Elytra at base not much wider than prothorax; with rows of moderately large punctures, becoming smaller and less regular at apical slope. Sides of prosternum striated from base to apex. Femora unarmed. Length, 2·75-3 mm.

Hab.—Northern Territory: Groote Eylandt (N. B. Tindale). Type, I. 15556.

A small dingy species, about the size of *R. megalops,* and with similar eyes, but there is a conspicuous impression between them, and the prothorax is wider and subopaque; in proportion the eyes are much as on the varieties of *R. apicipennis,* from Connexion and Woodah Islands, but the prothorax is subopaque, and the size is consistently less; the eyes are much closer together than on *R. apicalis,* and all its varieties. The elytra are slightly paler about apex than about base, but the shades are not sharply defined. Four specimens were obtained.

Colaspoides cariniventris, n. sp.

♂. Black, upper surface with a slight coppery gloss, under surface in parts with a coppery-green gloss, parts of legs dull red, palpi and four or five basal joints of antennae flavous, the others partly or entirely infuscated.

Head with numerous sharply defined punctures of moderate size, denser on clypeus than elsewhere; with a small inter-ocular fovea, and a small shining space near the base of each antenna. Eyes large and prominent. Antennae long and thin. Prothorax with sides strongly rounded and not dentate about middle, base distinctly wider than apex, hind angles feebly dentate; with rather large punctures, dense on sides but irregular about middle. Elytra about one-fourth wider than prothorax; with rather coarse punctures, more or less confluent behind shoulders, confined to striae between costate intervals on apical slope. Flanks of prosternum with some large punctures. Abdomen with small and moderate punctures, becoming coarse on intercoxal process; fourth segment twice the length of third, a shining flat ridge along middle, on each side of which is a depression; fifth segment short, the middle of its apex widely notched for the intrusion of pygidium; the latter with an acute median ridge. Legs rather long; front femora feebly but acutely dentate. Length, 5 mm.

♀. Differs in being shorter and more convex, antennae shorter, with fewer joints pale, prothorax more transverse, abdomen more convex, with sparser punctures, those on the intercoxal process smaller, fourth segment simple, no longer than third or fifth, the fifth gently and evenly incurved at apex, and the legs shorter, with the basal joint of the front and middle tarsi smaller.

Hab.—Northern Territory: Groote Eylandt (N. B. Tindale). Type, I. 15557.

Evidently belongs to the second section of *Colaspoides*, but has more the appearance of *C. hoblerae* of the first section, from that species it differs in being more compact, in the front femora and in the abdomen of the male. It has the general appearance of *Geloptera armiventris*, but the sides of the prothorax are unarmed (except for the basal angles), and the abdomen of the male is very different. Owing to the irregularity of its punctures the pronotum appears to have five feeble elevations, on the elytra there are also some feeble elevations, due to the irregularity of punctures. The abdomen of the male has two irregular rows of long dark hairs. Three specimens were obtained.

Colaspoides excaviventris, n. sp.

♂. Black, with a coppery or coppery-green gloss, legs reddish, in parts infuscated, palpi and four or five basal joints of antennae flavous, the others partly or entirely infuscated.

Head with rather dense, sharply defined punctures of moderate size; with a faint inter-ocular depression, and a small shining space near the base of each antenna. Prothorax with sides strongly rounded and unarmed, except for the basal angles (which are very feebly produced); with dense and rather coarse punctures near sides, becoming smaller and irregular about middle. Elytra rather elongate; with strong punctures, frequently transversely confluent, but on apical slope mostly confined to striae between well defined costae. Flanks of prosternum with large punctures. Abdomen with sparse and inconspicuous punctures, except for some rather large ones on intercoxal process; fourth segment almost flat in middle, more than twice the length of third, and widely excavated for the reception of fifth segment; the latter excavated to receive the pygidium. Legs rather long, especially the hind tibiae, front femora minutely dentate. Length, 4-4·5 mm.

♀. Differs in being slightly wider and more convex, abdomen more convex, fourth segment no longer than third or fifth, and not excavated at apex, inter coxal process with sparser and smaller punctures, and antennae and legs shorter, with the front femora unarmed.

Hab.—Northern Territory: Groote Eylandt (N. B. Tindale). Type, I. 15561.

Referred to *Colaspoides* for the same reasons as for the preceding species, from which it differs in being smaller and less robust, with a more distinct

greenish gloss, and in the abdomen of the male. The tooth on each front femur of the male is very small but quite distinct from some directions. Six specimens were obtained.

Tomyris antiqua, n. sp.

♂. Of a rather dull coppery-green, becoming bright on parts of upper surface, labrum, antennae (except extreme tip), palpi, and legs (except claws) flavous. Upper surface densely clothed with short, depressed, uniform, pale pubescence.

Head wide; with small crowded punctures, with a small shining space near the base of each antenna, and with a small median carina. Eyes large and prominent. Antennae long and thin, extending beyond hind coxae. Prothorax with punctures much as on head. Elytra with slightly larger punctures than on prothorax. Fifth segment of abdomen with a small median fovea. Length, 3 mm.

♀. Differs in being slightly wider, upper surface coppery, parts of under surface coppery-red, antennae shorter with five or six apical joints partly or entirely infuscated, abdomen more convex, non-foveate, and legs shorter.

Hab.—Northern Territory: Groote Eylandt (N. B. Tindale). Type, I. 15559.

The prothoracic pubescence from some directions appears to be parted in the middle, but rather less distinctly than on *T. mediana*, from which it also differs in being smaller and more compact, and with more of the antennae of the female dark; passing that species in my table it would be associated with *T. queenslandica*, which is smaller, narrower in proportion, and much darker; the only other species known from the Northern Territory is *T. longa*, which is a much larger and otherwise very different species. The elytral punctures, although larger than the others on the upper surface, are not individually distinct, they cause the derm to appear very finely granulated. One male and nine females were obtained on the island.

Sphaerophyma armipes, n. sp.

Flavous, a discal spot on pronotum, most of sterna, base of abdomen, and apical half of antennae more or less deeply infuscated.

Head minutely punctate. Eyes large and rather close together. Antennae rather long, very close together at the base, first joint about as long as the three following combined, five apical joints conspicuously flattened. Prothorax at base about four times as wide as the median length, sides strongly narrowed to apex, narrowly margined, but margins slightly dilated at apex; with dense and sharply defined punctures; with three small foveae: a medio-basal one, and a smaller one almost midway between this and each of the front angles. Elytra rather wide, sides evenly rounded; with almost regular rows of fairly large, sharply defined punctures, the interstices with numerous smaller but also sharply defined ones. Abdomen with an elongate-oval elevated space on inter-coxal process, apical segment longitudinally impressed. Hind femora very wide and subtriangular; hind tibiae conspicuously grooved along upper surface, outer edge subtriangularly notched near apex, inner edge rather strongly incurved there, apex strongly incurved, with one side acutely produced, in addition with a strong stout spur fully as long as two basal joints of tarsi; basal joint of hind tarsi slightly longer than two following joints combined. Length, 2·5 mm.

Hab.—Norfolk Island (A. M. Lea). Type, I. 7625.

Having taken but a single specimen on the island, it does not appear desirable to break it to be sure of the front coxal cavities, but placed side by side with a specimen of *Sphaerophyma simoni* it appears to have the same kind of sterna (the intercoxal process of the mesosternum appears as a narrow transverse line on both), similar elytral epipleurae, the same curious abdominal elevation, and

very similar hind legs. From *simoni* it differs in being much smaller, narrower, punctures more pronounced, pronotum with three small foveae, and hind tibiae with longer spur. The colour is probably not to be depended upon. The type appears to be a male.

Crepidodera fuscitarsis, n. sp.

Castaneo-flavous, legs flavous, the tarsi infuscated, antennae with basal half (or less) flavous, the rest infuscated.

Head rather large, base strongly convex, a narrow carina in middle separating bases of antennae; almost impunctate. Eyes rather large, moderately prominent, rather coarsely faceted. Antennae rather long and thin, first joint about as long as second and third combined, third slightly longer and thinner than second, the others subequal. Prothorax strongly convex, about once and one-half as wide as long, apex truncate, base lightly bisinuate, margins very narrow, subangulate in front, near base with a light bisinuate impression; with dense but small and inconspicuous punctures. Scutellum small and strongly transverse. Elytra subovate, widest near basal third, shoulders strongly rounded; with rows of rather large punctures in light striae, both punctures and striae becoming feeble posteriorly, interstices almost impunctate. Legs rather short; hind tibiae feebly mucronate at apex, not longitudinally grooved; claws each with a stout basal appendix. Length, 3·25-3·75 mm.

Hab.—Lord Howe Island (A. M. Lea and wife). Type, I. 7624.

The front coxal cavities are seen (with the prosternum separated from the mesosternum) to be conspicuously closed behind, hence, according to Blackburn's table of the subfamily,[7] the species, as it agrees with other characters of that table, could only be referred to *Crepidodera*, unless to a new genus (and this I am not prepared to propose). In several British species of *Crepidodera* (in the Museum) the transverse impression of the pronotum abruptly ends in a longitudinal one, some distance from each side; in the Queensland *C. indicica*, the longitudinal impressions are shorter but still well pronounced; but on the present species the longitudinal impressions are but vaguely indicated and the transverse impression is feebly continued beyond them. The base of the head is vaguely infuscated, and on one specimen there is an infuscate spot on the pronotum; some specimens have the under surface considerably darker (almost black) than the elytra; the suture is usually lightly infuscated at the summit of the apical slope, and there is usually a vague infuscation extending backwards from each shoulder to about the middle of the elytron. Five specimens were beaten from ferns from the summit of Mount Gower.

Two specimens, obtained under similar circumstances to the others, are somewhat smaller, more brightly castaneous, with the post-humeral infuscations more pronounced, and the prothoracic punctures larger and more sharply defined.

Crepidodera instabilis, n. sp.

Castaneous, elytra maculate or not; under surface black or blackish, antennae flavous, becoming infuscated towards apex, legs flavous, the hind femora castaneous.

Head much as in preceding species, except that the eyes are slightly larger; antennae shorter but otherwise much the same. Prothorax with outlines much as in preceding species, but the transverse bisinuate impression more sharply defined, and the punctures larger and more sharply defined, although still small. Elytra distinctly wider than prothorax at base, sides dilated to beyond the middle; punctures and striae much as in preceding species. Length, 2·25 mm.

Hab.—Lord Howe Island (A. M. Lea and wife). Type, I. 7622.

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[7] Blackb., *Ante*, 1896, pp. 40, 41.

Certainly congeneric with the preceding species, but still more aberrant from *Crepidodera,* by the entire absence of longitudinal impressions from the disc of the pronotum, and by the transverse impression continued without interruptions to the fine lateral gutters. On breaking off the prothorax, and examining the front coxae directly from above, their cavities appear to be open behind, but on examining them from behind a narrow depressed ridge is seen to connect the inter-coxal process with the outer portion, although less noticeably so than on the preceding species. Of this species twelve specimens were obtained: nine by beating ferns on the summit of Mount Gower, and three from tree-ferns on Mount Ledgbird; six of the former are of uniform size (2·25 mm.), and of these two, A, have a large blackish isolated median spot on the disc of each elytron; two, B (including the type), have each spot extended to the shoulder and side, so as to occupy a large subtriangular space; one, C, has the spot similarly extended but not so deeply infuscated, and the sixth has the spots scarcely indicated. The three from Mount Ledgbird are slightly larger (2·5-2·75 mm.); two, D, are entirely pale, except for a slight infuscation of the antennae, and the third, E, has spots as on A, and in addition an infuscate spot on the pronotum. The other three from the summit are still larger (2·75-3 mm.); one, F, is entirely pale, except that the antennae are deeply infuscated towards the apex, and that the head and prothorax are of a brighter castaneous than the elytra; one, G, has the elytra pale, except for a slight infuscation of the suture and punctures, but its under surface and apical two-thirds of the pronotum are rather deeply infuscated; the other specimen, H, has the black markings extended to cover most of the elytra, leaving only a bisinuate space on each side, and an obscure spot close to the suture pale, it has a deeply infuscated spot on the pronotum, and most of its under surface is black, with the hind femora partly infuscated.

Goweria, n. g.

Head moderately large. Eyes moderately large, prominent and coarsely faceted. Antennae rather long and thin, rather close together at base. Apical joint of maxillary palpi conical, not much longer than the subapical one. Prothorax strongly convex, widely transverse, margins very narrow, without discal sulci. Scutellum very small. Elytra strongly convex, with rows of large punctures in light striae. Legs rather short; hind femora very stout; hind tibiae lightly mucronate; basal joint of hind tarsi as long as two following joints combined, claws each with a stout basal appendix.

In Blackburn's table of the *Halticides,* would be associated with AA (on breaking off the prothorax the front coxal cavities appear to be widely open; on looking at them from behind a narrow ridge, considerably below the level of the inter-coxal process, is visible, exactly as on *Sutrea,* given in the table as having the cavities open behind), BB, CC, D, E, F, G, H, I, J, KK—*Phyllotreta;* from which it differs in the shape of its head and prothorax, and in the striation of its elytra. In its head and elytra it approaches the two preceding species, but the complete absence of discal sulci from the pronotum would appear to forbid its reference to *Crepidodera.*

Goweria obscura, n. sp.

Black or piceous, some parts paler.

Head with a bisinuate impressed line from eye to eye, a narrow carina between bases of antennae; almost impunctate. Antennae slightly passing base of abdomen, first joint slightly longer than second and third combined, second slightly shorter and stouter than third, the others to tenth subequal in length and slightly increasing in width, eleventh distinctly longer than tenth. Prothorax about once and one-half as wide as the median length, but more than twice the

length of the sides, apex truncate, base lightly bisinuate; margins very narrow and oblique but subangularly dilated in front; punctures very minute. Elytra widest at about basal third, shoulders strongly rounded; with regular rows of rather large punctures in light striae, becoming smaller posteriorly. Basal segment of abdomen slightly longer than three following combined. Length, 2·5-2·75 mm.

Hab.—Lord Howe Island (A. M. Lea and wife). Type, I. 7623.

Seven specimens were obtained on the summit of Mount Gower; they are all very dark, but only one specimen could be regarded as having most of the upper surface really black; the type (and several specimens agree well with it) has the head and prothorax of a very dark castaneous, the prothorax with a black (but not sharply defined) fascia across its middle, and the apex of elytra (and base to a less extent) diluted with castaneous; the legs and basal half of antennae are more or less obscurely castaneous; the abdomen is usually obscurely pale at the tip; one specimen has the hind femora infuscated.

Three specimens, obtained at a much lower elevation, probably also belong to the species, but differ from the types in being smaller and differently coloured. One is castaneo-flavous, with a sharply defined black fascia across the prothorax, and a large black post-humeral blotch on each elytron, its under surface and tarsi are infuscated; the second is of a rather bright castaneous, with the elytra, legs, and abdomen pale flavous, and on each elytron an infuscate post-humeral blotch; the third is still paler, with the post-humeral blotches not traceable; all three have the antennae pale at the base and dark at the apex.

Adimonia fugitiva, n. sp.

Of a dingy livid flavous, a medio-basal spot on head and three large spots on pronotum black; antennae blackish, bases of the joints, and under surface of the basal ones pale. Rather densely clothed with very short pubescence.

Head with rather small but crowded punctures; with a narrow median carina. Antennae moderately stout, passing base of abdomen, first joint slightly shorter than second and third combined, second distinctly shorter than third, fourth slightly longer than fifth, and distinctly longer than third, the others slightly decreasing in length, but eleventh slightly longer than tenth. Prothorax more than thrice as wide as long, sides rounded, basal angles rounded, the front ones acute; surface shagreened, and punctures usually not sharply defined; with five shallow depressions. Elytra distinctly wider than prothorax, almost parallel-sided; with crowded and sharply defined but not very large punctures, the interspaces minutely punctate; epipleurae moderately wide at base, disappearing well beyond the middle. Legs rather short and stout; tibiae acutely carinated externally; claws bifid. Length, 5-7 mm.

Hab.—Lord Howe Island (A. M. Lea and wife). Type, I. 4462.

The species belongs to *Adimonia* as defined by Blackburn (*Ante*, 1896, p. 86), except that the third joint of the antennae is distinctly shorter than the fourth, instead of longer; it is about the size of *A. elegans* and *A. richmondensis*, but has the prothoracic impressions much less pronounced and punctures smaller, four basal joints of antennae very differently proportioned, etc. The colour is now as described, but living specimens are of a beautiful pale green. Of the spots on the pronotum one is round and near the base at the middle, the others are submarginal and vary somewhat in shape. The cephalic carina is sometimes sharply defined from the base to the clypeus (just before which it is interrupted), on some specimens it is feeble towards the base, but it is always conspicuous (and usually thicker than elsewhere) on the clypeus.

The species occurs also in Northern Queensland (Blackburn's collection), Cairns (E. Allen, J. A. Anderson, and A. M. Lea), and Port Denison (Macleay Museum).

Brontispa castanea, n. sp.

Castaneous and shining, legs slightly paler than upper surface.

Head produced in front of eyes, then rectangularly narrowed, and with a conspicuous grooved median projection; with coarse punctures between and in front of eyes, smooth at base. Antennae rather stout, slightly longer than head and prothorax combined. Prothorax about as long as wide, sides gently incurved, but near apex suddenly and strongly narrowed, and lightly notched, basal angles notched, near base with a narrow impression, deep across two-thirds, but traceable to the sides; with fine punctures, almost evenly distributed, but large and deep on sides. Elytra very long and thin; each with eight rows of large, deep punctures on basal half, and near apex, but ten between these parts, interspaces with minute punctures, suture and second interstice carinated posteriorly. Under surface with minute punctures. Legs short and thick; tibiae suddenly curved at base and again at apex. Length, 8-9·5 mm.

Hab.—Lord Howe Island (A. M. Lea). Type, I. 7628.

Structurally rather close to *B. froggatti*, but uniformly coloured, projection between antennae wider and slightly dilated to its truncated tip, prothorax with different punctures and angles, a narrow deep impression near its base, and elytral punctures not so closely spaced. A single specimen was beaten from a *Kentia* palm, there was another (damaged) specimen in the Australian Museum, and Mr. A. Musgrave recently took three more on the island.

A NOTE ON THE OCCURRENCE OF THE RAT MITE, LIPONYSSUS BACOTI, IN SOUTH AUSTRALIA, TOGETHER WITH DESCRIPTIONS OF CERTAIN STAGES.

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[Read June 10, 1926.]

The rat mite, *Liponyssus (Leiognathus) bacoti*, Hirst, first came under notice in South Australia, in February last, as a result of a communication from the city medical officer, who stated that shop assistants in a stationery establishment, in Adelaide, had complained of being bitten by tiny "insects," which on examination were found to be mites and were provisionally identified by me as *Liponyssus bacoti*.

It was reported that rats were common in the building, and with a view to ascertaining if they were the sources of the infestation a request was made for rats, preferably alive, from the premises. Specimens of the grey rat, *Rattus norvegicus*, both half-grown and adult, were found to have large numbers of these mites on them. They were in the nymphal and adult stages and a few engorged females, and some nymphs left the rats while the latter were still alive. Specimens of the mites were forwarded to Mr. Stanley Hirst, of the British Museum, who confirmed the identification as *Liponyssus bacoti*, Hirst.

It was first described as *Leiognathus bacoti* by Hirst, in 1913 (4), from specimens from Egypt, and is now known from many parts of the world.

This is the first record of the mite from South Australia, though it was recorded from Western Australia as long ago as 1908, and it does not seem likely that it is a newcomer to Adelaide.

The earliest discovery of it appears to have been at Fremantle, Western Australia, in 1908, referred to by Dr. E. W. Ferguson (3), when Dr. J. B. Cleland reported that it was attacking human beings working on the wharves. Ferguson (3) has also recorded that in January, 1914, it was found attacking workers in a boot factory in Sydney. In this case the occurrence was traced to rats. In March, the same year, mites caused similar trouble in a shop adjoining the boot factory. In this case mites were numerous in the building and traces of rats were common.

Although *L. bacoti* has never been recorded from South Australia before, it seems quite probable that it was the same species which was mentioned as attacking human beings in Adelaide in 1912. Dr. Cleland (2) states that "the employees of a manufacturing stationer were much bothered by small mites getting on their persons." On this occasion "rats, *Mus decumanus (Rattus norvegicus)*, were present in large numbers, even nesting among old papers," and "in such situations mites were in abundance and easily crawled on to those turning over the litter." Some of these mites were submitted to Dr. T. Harvey Johnston, who found that they "approximated to *Laelaps agilis*," though they differed in certain marked characteristics. *L. bacoti* at that time had not been described, so that it seems quite a reasonable possibility that the mite in question was *L. bacoti*.

In addition to Australia it has been obtained from Egypt, the type locality, Abyssinia, and Argentine (4), also the United States of America (1) and South Africa (6).

Although *L. bacoti* was found on *Rattus rattus* and *Acomys cahirinus* in addition to *Rattus norvegicus,* in Egypt, the last-named seemed to be the principal host. This seems to be borne out both in America and in Australia. Bishopp (1) states that in United States of America all infestations investigated by him were "shown to have been associated with *Rattus norvegicus*." The initial outbreak of the mite as a pest of man at Dallas, United States of America, "was coincident with a tremendous increase of rats in the city."

The problem of controlling the mite is thus one of controlling the rats. Speaking of the American outbreak, Bishopp states "when the rats are driven out, the mite trouble soon subsides." The same has been found to be the case in Adelaide, where the dual task of reducing the rat population and spraying the building to destroy any mites which were still running about, has abated the nuisance.

As far as is known at present no more serious consequences have arisen from attack by these mites other than intense irritation and inflammation which may last for some days, but with rats acting as the carriers of disastrous diseases the occurrence of these blood-sucking mites is one which should always have immediate attention.

No adequate reason seems to have been advanced yet as to why the mites leave the rats in such numbers as to become an annoyance to humans. Bishopp says "it was thought, at first, that the scattering of hungry mites might be due to the destruction of their normal hosts, the rats, but later observations did not substantiate this, as mites were found in great numbers where the rats were abundant and had not been disturbed." The presence of mites in the Adelaide shop was not due to the destruction of their normal hosts. Bishopp also suggests that "comparatively few mites found on the bodies of rats when running about away from burrows indicates that mites feed largely on young or adult rats while quiet in nests and hiding places, and that they detach themselves and remain in such situations." This may be a partial explanation. I have had live rats *(R. norvegicus)* under observation and have observed engorged female mites leave them and crawl away. These females were confined in tubes and eggs were deposited by the following day. Hence, it would appear that one reason for mites leaving their host is the desire to oviposit. Moreover, the mites collected in the shop were adult females with very little ingested blood, and this lends support to the idea. However, this cannot be the sole reason, as younger mites have also been observed leaving the rats. It is possible that, in the case of the nymphs, they leave in order to moult, but at present there is no evidence in support of such an idea. However, it was noted that such nymphs were fairly well fed and red with ingested blood.

Engorged females are deep blood-red, but when deprived of food they assume a sooty colour, after a day, and on the second day are straw coloured with sooty markings, due to the blood in the caeca of the alimentary canal. Mites found free in a building are usually of this colour owing to the lack of ingested blood. On the third day, the body, which has decreased in size, is flatter and inclined to be slightly pyriform rather than elliptical in outline.

The eggs are relatively large for the size of the mite, and as many as nine may be laid without the female taking additional food. In one case four eggs were laid on the first day, four on the second, and one on the third. This particular mite lived for five days after the last egg was laid, and during that time fed on blood serum [1] which was provided for it. This suggests that, normally, females will feed again after laying a batch of eggs, and may possibly lay more than one batch.

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(1) Löffler's blood serum culture medium. The blood used in the manufacture of the medium was horse blood.

The Egg.

The egg is elongate with rounded ends, smooth and shiny white, measuring ·35 mm. to ·36 mm. in length and ·22 mm. across.

Of those laid in captivity, all except one were deposited on or just under the cotton wool forming the plugs of the tubes in which the mites were confined.

In less than a day more than three-fourths of the contents of the egg is seen to have become more dense than the remainder, which is clear and glassy white and occupies one end. The eggs hatch in two days (dry summer weather).

Larva.

The larva is white with the body bluntly elliptical in outline. The body measures ·33 mm. to ·34 mm. long and ·21 mm. wide, and measured from the posterior of the body to the tips of the extended palpi is ·41 mm. The hairs on the legs are short and those on the body very sparse and short, except on the posterior of the abdomen, where they are much longer. A very striking feature of the larva is the presence of three pairs of long hairs on the posterior of the abdomen and curved as in fig. 1, B.

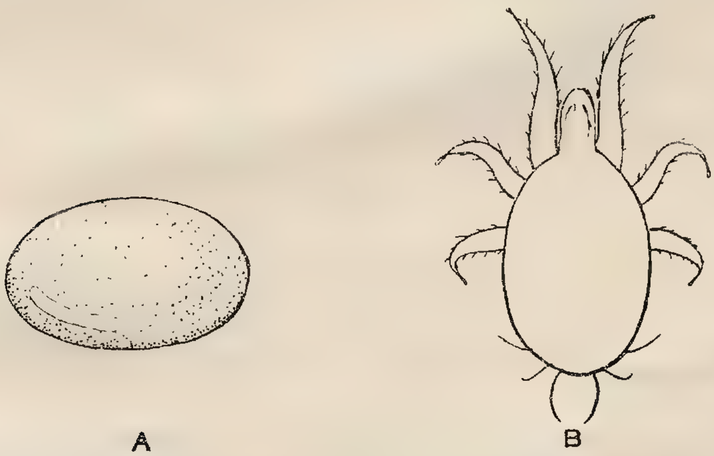

Fig. 1. A. Egg of *Liponyssus bacoti,* Hirst, greatly enlarged.
B. Larva of *L. bacoti,* drawn to the same scale.

The larva moves about very sluggishly. In the cases under observation they moulted after a day without having partaken of any food. It would appear that there is some physiological reason for such a remarkable fact, but at present it is difficult to advance one. The nymph which succeeds the larva is much more active.

Protonymph.

The stage following the larval stage is the protonymph in which the fourth pair of legs appears.

It has been described in detail by Hirst, and, in addition to his description of its structure, the following notes made from live, freshly-moulted nymphs are added:—

Just after emergence from the previous stage and before partaking of any food the protonymph is practically equal in size to the larva. It is ·34 mm. long and ·21 mm. wide. The nymph is white and the outline of the body is not quite so nearly elliptical as that of the larva, the sides being more nearly parallel. The hairs on the body are more conspicuous than those on the body of the larva and

those on the posterior of the abdomen are relatively shorter than on the larva, the pair nearest the middle line, however, being slightly more prominent than the others.

The spiracles are situated between the third and fourth coxae on the ventral surface.

The mite in this stage moves more actively, running rather than crawling, as is the habit of the larva. However, it often progresses on the posterior three pair of legs, at the same time holding the first pair out in front and waving them from side to side as if they were sensory in function.[2]

Nymphs of this stage have remained alive in glass tubes without food or moisture for eight days in hot dry weather. One nymph which was measured after five days' imprisonment was ·32 mm. long and ·20 mm. wide.

Protonymphs may be as large as ·50 mm. long and ·27 mm. wide and ·60 mm. from the posterior of the body to the tips of the palpi.

I am indebted to Professor J. B. Cleland for certain of the references to the occurrence of this mite in other parts of Australia, also to Professor Harvey Johnston for reading through the proofs of this paper.

Summary.

The rat mite *Liponyssus bacoti*, Hirst, is recorded for the first time from South Australia and notes on the occurrence are given.

The egg and larval stages are described. The larva moults without partaking of food.

Notes on the protonymph are also given.

Literature referred to.

1. Bishopp, F. C.—1923, "The Rat Mite attacking Man." U.S.D.A. Dep. Circ. 294.
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3. Ferguson, E. W.—1915, Sixth Report of the Microbiol. Lab. (Gov. Bur. of Microbiol.) for 1915, p. 253. (Extract from Rep. of the Director-General of Public Health, N.S. Wales, for 1915).
4. Hirst, S.—1913, "On three New Species of Gamasid Mites found on Rats." Bull. Ent. Res., iv., pp. 119-124.
5. Hirst, S.—1914, "On the parasitic Acari found on the species of Rodents frequenting human habitations in Egypt." Bull. Ent. Res., v., pp. 215--229.
6. Hirst, S.—1925, "Description of new Acari, mainly on Rodents." Proc. Zool. Soc. Lond., pp. 49-69.

(2) Adults which have been prevented from obtaining food have a similar habit. It would appear that sitotropic receptors may be present on the tarsi of the front legs, as has been found to be the case in certain ticks.

THE GEOLOGY OF THE VICTOR HARBOUR, INMAN VALLEY, AND YANKALILLA DISTRICTS, WITH SPECIAL REFERENCE TO THE GREAT INMAN VALLEY GLACIER OF PERMO-CARBONIFEROUS AGE.

By Professor Walter Howchin, F.G.S.

[Read June 10, 1926.]

Plates VII. to XVI.

CONTENTS.

I. INTRODUCTION.

Of late years the evidence has been gradually strengthening that near the close of the Palaeozoic Era a period of intense glacial conditions prevailed over a large portion of the earth's surface. Whether both hemispheres shared in this refrigeration of climate to the same degree is not very clear, but the remains of this glaciation in the Southern Hemisphere, both with respect to its geographical extent and the low latitudes to which the ice was carried suggests that it was a period of unexampled severity.

The Talchir and the Salt Range beds of India, the Dwyka of South Africa, and the Tillite of the Permian beds of the Falkland Islands [Halle], are among the best known localities outside Australia. Other localities are: Parana, Brazil,(1) Argentina, and, with less definite evidence, the Kinta District, Perak, Federated Malay States,(2) and, more recently, what appear to be important evidences of Permian glaciation have been obtained from the neighbourhood of Boston, U.S. of America.(3)

(1) J. B. Woodworth, Bull. Mus. Comp. Zoology, Harvard College, vol. lvi., No. 1, Geolog. Ser., vol. x., Shaler Memorial Series, No. 1 (Nov. 1912).

(2) J. B. Scrivenor, Geologist to Fed. Malay States, Geol. and Mining Industries of the Kinta Dist., Perak. Govt. Printer, 1913.

(3) R. W. Sayles, The Squantum Tillite, Bull. Mus. Comp. Zoology, Harvard College, vol. lvi., No. 2, Geolog. Ser., vol. x. (1914).

It is a remarkable fact that these glacial beds of the Southern Hemisphere synchronize with a complete change of flora. The typical and very characteristic plants of the Carboniferous Period entirely disappeared and a new flora, destined to be characteristic of the Mesozoic periods, took their place. It seems probable that very great modifications of climate over large portions of the earth's surface occurred at that time, which wiped out most of the older vegetation and prepared the way for new forms that were more suited to the altered conditions. While this is particularly true of the glacial areas, in other parts of the world the two floras, to some extent, overlap and commingle.

The first evidences of ice-marks on the Australian continent were obtained in the Inman Valley, by A. R. C. Selwyn, Government Geologist of Victoria, who, in 1859, made a hasty examination of the geological features of the country from Cape Jervis to Mount Serle, in the northern Flinders Ranges. This experienced field geologist was quick to note a small patch of an ice-smoothed and striated pavement exposed by the wash of the River Inman. In his official report he states:—

"At one point in the bed of the Inman I observed a smooth striated and grooved rock surface; presenting every indication of glacial action. The bank of the creek showed a section of clay and coarse gravel or drift, composed of fragments of all sizes, irregularly imbedded through the clay. The direction of the grooves and scratches is east and west in parallel lines, or nearly at right angles to the strike of the rocks; and though they follow the course of the stream, I do not think that they could have been produced by the action of the water, forcing pebbles and boulders detached from the drift, along the bed of the stream. This is the first and only instance of the kind I have met with in Australia, and it at once attracted my attention—strongly reminding me of the similar markings I had so frequently observed in the mountain valleys of North Wales." (1)

Selwyn offered no suggestion as to the age of the glaciation nor did he correlate the polished pavement, he discovered, with the great thickness of glacial till and large erratics which overspread the whole of that country.

In 1877 the late Professor Ralph Tate discovered a glaciated pavement at Hallett's Cove, and at a meeting of the Philosophical Society of Adelaide, held on the 5th of February, 1878, it is recorded that he "exhibited a piece of rock from Hallett's Cove which showed a polished and scratched surface indicative of glacial action," (2).

In 1885 Mr. R. D. Oldham, the Superintendent of the Geological Survey of India, obtained a glacially striated boulder from the upper marine beds, at Branxton, New South Wales, which he regarded as the equivalents of the Talchir beds of India, thereby defining an Australian glaciation during the Permo-Carboniferous Period (Mem. Geo. Sur. India, vol. xix., p. 44).

In 1887 Tate read a paper at the first meeting of the Australasian Association for the Advancement of Science (Sydney) in which he gave particulars of his discovery of glacial remains at Hallett's Cove, and considered that it was "highly probable" that the glaciation was of Post-Miocene age, (8).

At the Adelaide meeting of the Australasian Association, in 1893, a small committee was appointed, assisted by a financial grant from the Association, to carry out excavations at Hallett's Cove to determine the stratigraphical relationship of the glacial till to the outcrops of the marine Miocenes of the neighbourhood. It was then demonstrated that the till occupied a position inferior to that of the Miocene [Austr. Assoc. Ad. Sc., vol. vi. (1895), p. 315].

In 1897, Professor T. W. Edgeworth David and the present writer visited the Inman Valley for the purpose, if possible, of finding the polished pavement mentioned by Selwyn. A fine example of the kind was discovered in the bed of the stream, a little west of the seventh mile-post from Victor Harbour, with others of less size, as well as large numbers of erratics encumbering the river channel and scattered over the adjoining slopes, (19). Pl. ix., fig. 2.

Subsequent discoveries, of a like kind, were made throughout most of the country lying to the southward of the Willunga Ranges, including the valley of the River Finniss, Mount Compass, Waitpinga to Cape Jervis, the eastern side of Kangaroo Island, and the southern half of Yorke Peninsula, references to which will be found in the Bibliography at the end of this paper.

II. PHYSIOGRAPHICAL.

The Inman Valley forms a part of a physiographical block-unit that can be defined by the Willunga Ranges, on the north; Gulf St. Vincent, from Sellick's Hill to Cape Jervis, on the west; Cape Jervis, Victor Harbour to the Murray mouth, on the south; and the mouth of the River Finniss to near Strathalbyn, on the east. This area, in its superficial features, is dominated by Permo-Carboniferous glacial remains.

The surrounding highlands are the residuals of a Pre-Cambrian peneplain, more or less broken by earth fractures and river dissection that have operated through long ages. The conspicuous heights are Mount Compass, Mount Jagged (1,230 feet), and Mount Cone, on the eastern side; the Hindmarsh Tiers, forming the watershed of the Hindmarsh River, on the north-eastern side; Spring Mount, Scrub Hill, Moon Hill, and Kemmiss Hill, on the northern side. The southern barrier to the valley is formed by the Mount Desert and Mount Robinson range, at the head of the Back Valley Creek, and follows the watershed of the left bank of the River Yankalilla, making the dividing ridge between the Hundreds of Encounter Bay and Waitpinga. The Bald Hills form the watershed of the peninsula—the River Inman finding its exit to the eastward, near Victor Harbour, into the Southern Ocean; and the rivers Bungala and Yankalilla, flowing to the westward, have their outlets into Yankalilla Bay, in Gulf St. Vincent.

As the Permo-Carboniferous glacial beds are relatively soft and yielding, they give way to the denuding agents much more quickly than the hard, crystalline and siliceous rocks on which they rest, the consequence is that the region is gradually resuming the physiographical features it presented at the time when the ice-sheet passed over it; or, in other words, there is being restored in the present day the main outlines which the locality presented in the late Palaeozoic time—a true "fossil landscape."

There are three factors which greatly influence the physiography of the district and produce strongly contrasted soils of a local character:—

1. The inliers of older rocks, when they consist of slates and schists, weather down to a strong and rich soil that grows forest trees and is excellent for purposes of cultivation. These soils occupy the slopes of the greater heights.

2. The upper beds of the glacial series are chiefly of a sandy nature and form a very light and poor soil that grows only a scrubby vegetation. This is seen in the secondary hills of the Inman and Hindmarsh valleys, and more particularly in the Mount Compass country where most of the ridges are of this kind. The line of division between the loose shifting sand of the glacial waste and the sedimentary soil of the older rocks is often very sharp. Thus in passing from Mount Compass township up the rise to Mount Jagged, we suddenly step from an almost worthless dune-like sand to rich garden and orchard soils which form the slopes of the higher ranges.

3. The lower beds of glacial origin are, typically, tenacious blue clays which are highly retentive. These are seen in the valley bottoms where the erosion has cut down to this level. Seepage from the surrounding porous sandstone finds its way down to the clay and flows out on the valley floor, which develops a swamp. Hundreds of these swamps of various sizes are found throughout the district, more particularly in the Nangkita, Mount Compass, Hindmarsh Tiers,

and Myponga localities. The swamps of the flats, the white sand of the lower heights, and the dark-brown soil of the ranges, make very striking contrasts both when viewed at their lines of contact and when viewed as a whole.

The deposits as originally laid down were powerfully influenced in their nature and extent by the local topography, as well as from the kind of rock which formed the floor of the ice-sheet. The greater heights received relatively small coverings of glacial waste while deep valleys with irregular outlines received correspondingly more. The ice-flood in scouring soft country reduced its transported material to sand and mud, carrying only a small proportion of erratics; but in ploughing through hard and resistent rocks, such as quartzite and granite, its path would be marked by trails of large boulders. It is under the last-named circumstance that we find the most impressive evidences of the extinct glacial phenomena in South Australia. A wide granite belt—remains of which are still left along the coast from the Murray to Kangaroo Island—lay within the zone of glaciation and paid an enormous toll to the ice-plough as it crossed this area. The old granitic barrier was deeply scoured, broken into fragments, and transported. The marvel is that, notwithstanding the inconceivably remote period in which this occurred and the geological changes that have swept over the country since then, so much of the old records have survived to tell their tale.

The valley of the Inman was probably pre-glacial and fluviatile in its origin, but it could scarcely have been a main line of drainage. The pre-glacial drainage being from south to north, the Bald Hills, which form a transverse ridge of the older rocks, and encloses the head of the valley, would have proved a barrier to a north-flowing stream until cut through in the process of river grading. It might, however, have formed the head waters of a lateral stream, the bed of which subsequently underwent extensive erosion and was otherwise modified by the ice-flow.

The Inman Valley, proper, has an average width of about five miles, but in its lower part, where it joins on to the Hindmarsh Valley (measuring from the head of the Back Valley Creek to the Hindmarsh River), it has a breadth of about ten miles. The deeper contours of the valley are still choked and obscured by glacial deposits. Its greatest depth is unknown, but a bore put down in the Back Valley Creek, within a mile of the south-western boundary ridge, showed a thickness of glacial sandstone and boulder clay of 964 feet, at which depth bed-rock was reached. This depth is about 800 feet below present sea level [H. Y. L. Brown, Record of Mines, S. Austr., 1908].

The River Inman has reached base level for some distance up from its mouth. The tidal area is more than a mile in length. Above this area the bed of the river is for the most part sandy, and in summer is largely dry, with a few waterholes where the water is borne up by glacial clay or a bar of old rocks. The river, within recent times, has cut for itself a small canyon in a wide river valley. The flood area, in the lower portion, is sometimes a quarter of a mile in width, there being a number of intricate waterways in scrub country. There appear to be two well-marked levels in the form of river terraces, the lower, at a height of 9-12 feet, and the upper, at 20-30 ft. The present valley, as a whole, has been excavated in glacial sands and clay. In a few places the old rocks show in the bottom of the stream, and in Section 173 the river has cut a deep gorge in these rocks.

Within the tidal area the cliffs consist of a bottom set of beds of old consolidated sand-dunes which weather into shelf-like ledges and are sometimes covered with travertine. Whilst the river is almost blocked at its outlet there is deep water on the inside of the bar. The broken edges of the indurated sands can be seen passing down almost vertically to deep water. Resting on these older consolidated sands is a bed of clay, about 6 feet in thickness, and this is

covered by blown sands that are red at bottom and white near the surface. The river is choked by the rapid waste of the country within the drainage basin.

The physiographical features of the Hindmarsh Valley are closely similar to those of the Inman. Alternations of level are indicated in both cases—of deepening by base-levelling, and of elevation, by raised sea beaches. Examples of the latter are seen in the banks of the Inman, and also at the mouth of the Hindmarsh River, in a small railway cutting at the viaduct that passes over the stream. These are estuarine beds that occupy a gutter of erosion in the glacial till.

A submerged shelf, or reef, of glacial sandstone gives rise to the shallow water of Encounter Bay. It extends for about a mile from the shore and is largely covered by *Serpula* growths that often take a circular "atoll"-like form. [See Howchin, Geological Memoranda (Sec. Contribution), Trans. Roy. Soc. S. Austr., vol. xlv., 1921, p. 25, pl. v.]

Economic qualities of the Soil. Speaking generally, the morainic material is of an argillo arenaceous character. A yellowish sandstone that goes down readily to loose sand and, in places, includes a considerable proportion of gravel, is very typical. The sand is often coarse and sharp. Its chief constituent is quartz with a small proportion of felspar. In some localities, as, for example, on the ridge going from the Inman Valley to Crossman's and the Grey Spur, the material is a coarse granitic sand which is used for road making. This is the *débris* that would naturally result from the scour of a granite floor and the disintegration of innumerable granite erratics. In wet places the sand sets into a toughish floor, but on the slopes it is loose and white, and on the top of rises in the ground is often cemented by iron oxides into a hard, flaggy, red sandstone. This class of country is typically represented by white, incoherent sand, while the surface soil is of very low grade. The silicates, set free from the igneous rocks by disintegration, are not in a condition to yield plant food; indeed, a humus soil scarcely forms except as a thin surface layer with a hungry subsoil. The soluble ingredients, as well as the decaying vegetation, are oxidised and pass away in the drainage, leaving a leached and poor soil behind. The evidence of this process can be seen when after partial stimulus (as, for example, where a household with its back-yard refuse and sheep-pen have existed) a local oasis of grass and weeds is established, but if the place be deserted, in a few seasons the vital stimulus in the soil is lost and the patch returns to a state of nature which is often even worse than before.

Under certain conditions this glacial sand may become very productive, as, for example:—

(a) In a zone of junction with older diversified rocks on a hill side, the dis integrated elements of the latter are washed down to the sandy ground, which is thereby enriched and becomes a productive loam.

(b) Along river flats, as in the case of the River Inman and the Myponga River and their tributaries, which bring down in their flood waters glacial clay as well as sand, and these are intimately mixed in building up alluvial flats.

(c) Where the ground has been bared to the glacial clay a strong stiff soil is formed which is retentive, and as this clay generally carries pockets and layers of sand, a good workable soil is often the result.

(d) If these clay flats are situated in the lines of drainage, water gathers on the surface producing a swamp herbage, and, in the course of time, thick beds of carbonaceous matter accumulate, making a light, spongy, and turfy soil, which, when drained and properly cultivated, becomes highly productive.

The natural herbage on the sandy ridges is proof of the poverty of the soil which is almost destitute of grass or other succulent plants. The Grass Tree

(Xanthorrhoea) is a very characteristic plant on these soils. With respect to the arboreal flora, according to Mr. Crossman, Blue Gum and Pink Gum show a preference for glacial clay, Stringy Bark grows chiefly on sandy ridges, and Peppermint on the slates and quartzites of the Adelaide Series.

III. THE GLACIAL FLOOR.

Archaean Rocks or Fundamental Complex (the Houghton Series).

The north-western portions of the Hundred of Encounter Bay are occupied by the beds that form an Archaean Complex. These are bounded on the eastern side by the Basal Grits of the Adelaide Series, and on the southern side by glacial deposits through which inliers of the Adelaide Series protrude in places. The fundamental rocks are typically granitoid in their nature. In most places they take the form of a biotite granite, with a great preponderance of pinkish orthoclase. Aplites, formed by quartz and felspar; and syenite, often banded and carrying epidote, are also common. Pegmatized schists with the pegmatite forming, sometimes, fully half the stone. Other varieties are biotite schists, often weathered to a dull, earthy-reddish, slate-like rock. Dark-coloured, heavy, and sometimes speckled basic dykes occur. A dyke of this kind, 35 feet wide, is seen in the upper portions of the Grey Spur Creek and can be traced for more than a mile in a north-easterly direction.

In following the creek which comes in from the westward to the Grey Spur, through Sections 84 and 139, aplites are a leading feature; inferior to which are phyllitic schists and hydro-mica schists with sporadic developments of aplite and metamorphic quartzites with developments of biotite. Higher up the creek is a metamorphic argillaceous quartzite having a dip S.E. at 70°, penetrated by veins and bosses of aplite. Near the north-eastern corner of Section 139 is a large granitic mass, 13 feet by 8 feet, by 7½ feet high, isolated, and resting on the surface, which might easily be taken for an erratic, but by a careful comparison it is seen to be identical with the rock on which it rests. No glaciated surfaces were observed on these old rocks. Whatever may have existed in the past, the present condition of disintegration of the surface of these highly felspathoid rocks renders such glacial features an impossibility.

The Fundamental, or Archaean, rocks which are continuous from the Grey Spur, westward, to the western limits of the Hundred of Encounter Bay, by way of Barn Hill, Sugarloaf Hill, and Town Hill, pass into the Hundred of Yankalilla by Moon Hill and Kemmiss Hill, situated on the northern boundary of the last-named hundred A range of these Archaean rocks comes southward from Kemmiss Hill, near to the main road east of Yankalilla, just behind the cemetery, where they end in a scarp face. The rock is of complex structure consisting of augen mica schist with intrusions of epidote syenite, lenticles of quartz, and veins of pegmatite.

The Adelaide Series ([?] Proterozoic).

Beds of this age formed most of the floor over which the great ice-sheet moved within the area under notice, and are mostly limited to the lower members of the series.

The Basal Grits and Conglomerates make a prominent feature. The main outcrop forms what was locally known as the "Dog Hill," and later, as the "Grey Spur" [pl. viii., fig. 1], so named by the late Mr. D. H. Cudmore, of "Adair." The spot is reached by crossing the Inman by the bridge known as "Crossman's Crossing," seven and a half miles from Victor Harbour, and following the road to Mr. J. J. Crossman's (two miles from the bridge) who lives within half a mile of the outcrop.(4) The "spur," which is 150 feet in height, consists of a coarse

(4) Most of the observations recorded in this paper were made prior to 1911, so that some of the local references may have become obsolete.

conglomerate formed of pebbles of very hard quartzite, quartz, aplite, etc., up to 18 inches in diameter, held together in a coarse arkose grit with much clastic ilmenite. The stones in the upper part of the bed are intensely worn and rounded, but towards the lower part the bed has been powerfully sheared and the pebbles gradually assume a flattened form and become drawn out in the direction of the shear plane, until reduced to lenticular cakes, and, finally, to horizontal quartz veins. [(35) Howchin, W., 1918, p. 343, fig. 267.]

This basal conglomerate rests unconformably on the Archaean Complex, but is cut off by a strike fault on the northern side which brings in the overlying laminated slates, and, further on, the quartzite, into contact with the older rocks. The fault has a north-east strike with a downthrow on the eastern side. The line of fault is marked by quartz at the surface. The beds on the north-western side of the conglomerate are intensely broken and quartz-veined with a peculiar open structure. [See figs. in text.]

THE "GREY SPUR."

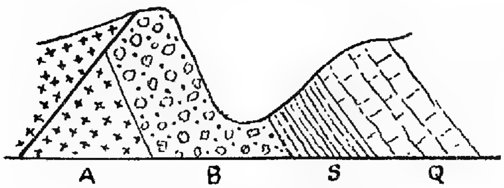

Fig. 1. Vertical Section.

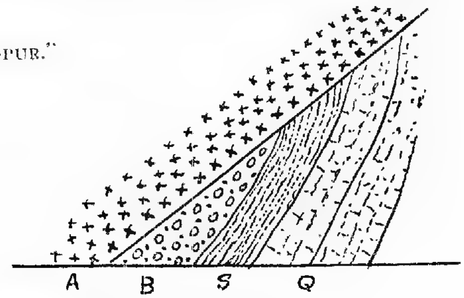

Fig. 2. Plan of Fault.

A, Archaean. B, Basal Grits. S, Slates. Q, Quartzite.

The conglomerate is seen again along the fault plane, at the south-western angle of Section 93, and can be traced, in a north-easterly direction, through Section 93, and the north-western angle of Section 94, to the ridge-road (as marked on the map, but is, really, covered by scrub) which follows the watershed that divides the Inman Valley from the Gum Tree Gully. The latter carries a swampy stream that empties into the large Edinburgh Swamp. The conglomerate trends across the Gum Tree Gully and forms the western banks of the Edinburgh Swamp. Throughout much of this line of outcrop the rock has been much disintegrated and the pebbles occur loose on the surface. The rock is intimately penetrated by quartz veins which may have contributed to the breaking up of the rock. Whenever the bed passes near the head of the gullies the disintegration is not so evident and the rock outcrops in huge blocks similarly to that seen at the Grey Spur. In all cases the junction between the conglomerate and underlying older series is sharply defined. The outcrop is in a direction N.N.E. from the Grey Spur, and covers a distance of three and a half miles.

There are two other outliers of the Basal Conglomerate, situated, the one two miles and the other two and a half miles to the south-westward of the Grey Spur. One of these is in Section 279, on the south-eastern flanks of the Barn Hill, on the right bank of a creek which is a tributary to the chief north and south creek known as Charley's Creek. In the bed of the creek, on the northern side of the outcrop, is a good exposure of the older series in the form of pegmatised schists with large folia faces showing a dip S. 20° E., at 37°. The grits and conglomerates are on the right bank, just above the stream, and run in a nor'-west by west direction exposing very large blocks and faces of coarse conglomerate near the top of the hill. The beds can be traced across a small steep creek and are then lost to view, probably cut off by a fault. Lower down the

small steep creek, just mentioned, the overlying slates can be seen with a dip S.E. at 57°. The strike of the conglomerate bed is 20° S. of W., and on the ridge S.W. and N.E. For about half a mile further to the south-westward, the conglomerate is replaced by the Pre-Cambrian schists and quartzites, but in Sec. 280 the conglomerate reappears in a strike 35° E. of N. This ridge goes down to the south-west corner of Sec. 280, in a direct line with Mr. H. T. Martin's house, where the rock passes out of view under the cover of the plain. Sugarloaf Hill, which succeeds on the western side, consists of the Pre-Cambrian slates and quartzites, and these continue in a westward direction.

On the northern flanks and towards the centre of the valley of the Inman the bed rock is a very hard siliceous quartzite which was well adapted to receive and retain the glacial polish and striae. Wherever this rock was seen exposed contiguously with the morainic material it was highly glaciated.

The Mount Robinson Range, which forms the southern boundary of the valley, is composed of fine-grained laminated quartzite. At the head of the Back Valley Creek the rock showed a zone in which the stone was brecciated, dip S. 10° W. at 45°. Near the Bald Hills, above Miss Mayfield's house [Sec. 348], the stone is a laminated micaceous quartzite, dip S. 20° E. at 58°. In a quarry on the ridge, a vein of quartz, two and a half inches wide, in the quartzite showed a selvage of quartz and felspar with small crystals of felspar in the quartz vein itself, approximating to a small intrusion of pegmatite. The slaty portions of the section are extremely contorted, being crushed into close folds and acute curves.

The bed rocks of the south-eastern portions of the Inman Valley (including the islands off the coast) differ considerably from those further inland. The coastal islands and the seaward portions of Rosetta Head [the Bluff] form part of a great granite belt of unknown width. The granite intrudes a sedimentary series which, as superior in position to the Basal Grits, can be no other than the Adelaide Series. Unfortunately, on account of the mantle of morainic material that covers most of the intervening space, a continuity of the rocks cannot be followed between the Grey Spur and the coast. The River Inman, in its lower portions, is choked by sand, except where it cuts through the rocks in a spur from Glastonbury Hill, and is therefore useless for the purpose. An attempt was made to find an order of succession by following up the Freshwater (or Deep) Creek which flows past the Grey Spur, but the course of the creek is at a rather low angle, as opposed to the strike of the beds, which did not give the best results. It was noted that, for some distance, the stream followed the strike, with phyllites (which follow next in order to the conglomerate) on its right bank and a fine-grained quartzite on its left. The dip slope of the phyllites to the creek gave the reading of E. 20° S. at 55°, increasing in places up to 80°. These phyllites vary in colour from light-grey to black, are sometimes finely laminated, and frequently contain quartz veins parallel with the folia. A few examples of a white to creamy coloured fine-grained marble were found among the gravel of the creek that closely resembled the Lower River Torrens-Limestone which occurs above the Basal Conglomerate in the Torrens Valley, but the rock was not seen *in situ*. A few specimens of a bluish calcareous rock and one or two examples of a black cherty rock were also picked up that were suggestive of the Upper River Torrens-Limestone. These beds are no more altered than are those that overlie the Basal Conglomerate near Adelaide.

On nearing the coast, by Glastonbury Hill, the evidences of metamorphic action become more apparent in the dark-coloured quartzite, known as "bluestone," which is quarried to obtain metal for the roads.

The granite of the coast is quite distinct from the Archaean granitoid rocks (that underlie the Basal Conglomerate) and of much later age. It is an intrusive

rock, and is therefore younger than the rocks which it intrudes. On the assumption that the latter belong to the Adelaide Series, the granite must be newer, at least, than the Proterozoic Age—possibly Cambrian.

On the beach road, going to the Bluff, the bed rocks are highly schistose and show anticlinal folds. They first dip S.E. at 45°, then N.W. at 50°, and then S. at 30°. Near the granite intrusion the schists are intimately penetrated by the granite and have undergone intense contortion.

Going up the road from Encounter Bay, over the rise to Hall's Creek (Sec. 179), there are quarries in hard siliceous schist-quartzite, similar to that at the top of Glastonbury Hill, with dip E. 20° S. at 65°. On the hill going up the Waitpinga Road the schists dip W. 30° N. at 75°. Along the coast, going west, the slates (or schists) dip to some point to the south-east, usually at a high angle. At the long line of cliffs, going to Newland Head, the slates have their dip slopes to seaward—dip E. 20° S. at 80°. The slates often show lamination, and, apparently, false bedding. The schistosity and bedding planes seem to be coincident.

Two igneous basic dykes occur on the landward side of the Bluff. One of these is situated on the shoulder behind the Bluff and is recognised from fragments turned up by the plough. Another much weathered dyke outcrops on the road going up the hill in the direction of Hall's Creek, on the eastern side towards the highest portion of the road. The dyke is about 20 yards wide [strike (?) S.W.] and has a vein of pegmatite, about six inches wide, near the middle.

In Section 6, just over the fence on the southern side of the road which comes down to the beach nearly opposite Wright's Island, there is an outcrop of coarse-grained crystalline marble, much resembling the Angaston marble. It occurs on the hillock which carries numerous erratics, near the beach road. The outcrop is in a slight hollow, on ploughed land, with the ordinary "bluestone" not far distant. Several good-sized boulders of the marble have been rolled on to the road near the fence, one of which measures 2 feet 6 inches in length. The proprietor of the land stated that several others had been carted away and broken up for road metal. One block of marble could be seen *in situ* where the others came from, and from the lie of the country the strike seemed to be S.W., with a S.E. dip. No other outcrop of the limestone was known to the owner of the field. There is just a possibility that these marble fragments may have been ice carried, but it scarcely seems probable, as in all the countless groups of erratics occurring in the district not a single example of a marble erratic has been noticed.

At the western end of the area under description the rocks that formed the bed of the glacier take on new features and are of more than one age. Within two miles of Yankalilla there is an outcrop of the Sturtian Tillite, one of the most distinctive horizons of the Adelaide Series. It occurs on the road to Myponga Jetty and is exposed in a cutting on the road, on the northern banks of the Carrickalinga Creek, in Section 445 (Hd. Myponga). This occurrence is of more than ordinary interest, as the tillite had not been previously proved in a southerly direction beyond the River Onkaparinga. Its presence in the Carrickalinga Creek is rendered remarkable, inasmuch as the newer (Permo-Carboniferous) tillite occupies the opposite bank, which is surely a unique occurrence that two great glacial formations, separated in time by many millions of years, should face each other in this way.

The area in which the Sturtian Tillite is included is greatly disturbed. The dip has a tendency to be vertical with alternations in direction, most frequently in an easterly direction. The slates are highly contorted and the rocks, generally, much intruded by quartz veins, especially the quartzites. The order of succession is a little obscure. On the eastern side of the tillite there is a succession of slates and quartzites, but these are more or less obscured by grass land. The beds, as

a whole, are suggestive of the slates and quartzites of the Glen Osmond and Mitcham Series. On the western side of the tillite there are dark-coloured laminated slates with a sericitic sheen on the laminae. These are well seen in a gully on the western side of the road, where they are much contorted. In the cuttings on the road they are capped and inlaid by superficial travertine. Following the Carrickalinga Creek in a westerly direction the slates have a banded structure (ribbon-slate), resembling the Tapley's Hill slates, and probably represent that formation, and if so, whatever their angle of dip they must be placed as superior in position to the tillite. It is a difficult region to interpret, geologically, and may include both reversions and faultings in its larger structures.

Two miles to the southward of Normanville is another exposure of pre-glacial rocks which cannot be easily correlated with other rocks in the neighbourhood. They form a bold ridge with Yankalilla Hill, a trig station, as the most prominent point. Two creeks intersect the ridge, the public road passing through the more southerly gap, which is known as the Little Gorge. The ridge forms a nearly perpendicular cliff facing the sea, from which it is set back for about 200 yards. The rocks had their origin in argillaceous sediments, but by metamorphic action they were altered to micaceous schists and subjected to hydrothermal injections in the form of quartz veins and layers, lenticles of a felspathoid character and pegmatites, which were developed sporadically, forming, in places, large masses. In some parts of the area, syenites, often coloured by epidote, and other igneous rocks occur.[5]

It is difficult to determine the geological position and age of these beds. They occupy an isolated position in consequence of the blinding effect of the Permo-Carboniferous Tillite which almost surrounds them. In some respects they resemble the Fundamental Archaean rocks that form the ridge situated about two and a half miles to the eastward, near the Yankalilla Cemetery. On the other hand, there are certain features about them which strongly suggest that they represent the metamorphosed equivalents of the lower members of the Adelaide Series. The discovery of the Sturtian Tillite, a little northward of Yankalilla, is an important point, especially as the strike of these beds is such that, if carried across the valley, would junction with the beds at the Little Gorge. A still more important factor for comparison is, that on the beach, a short distance to the southward of the Little Gorge, and apparently underlying these beds, is a very typical exposure of the Ilmenite Grits and Conglomerates which commonly form the basal beds of the Adelaide Series. Still further, these basal beds at the Grey Spur, in the Inman Valley, have been subjected to such an extraordinary degree of sheer-pressure that the large stones of the conglomerate, in its lower portions, have been rolled out into flat cakes. The same thing has happened to the pebbles in the bed at the base of the section at the Little Gorge. The Ilmenite Grits and Conglomerate continue southwards along the coast to Poole's Flat, near Second Valley, where limestones and other sediments put on at higher levels. There is a high probability that these beds represent the succeeding members of the Adelaide Series.[6]

The metamorphism and igneous intrusions in this isolated ridge may, possibly, be an outlying apophysis from the igneous magma that intruded the sediments on a much grander scale in the neighbourhood of the Bluff, Encounter Bay. Mr. R. G. Thomas (*loc. cit.*, p. 259) describes the presence of "bluish quartz" in the rocks at the Little Gorge. This is also a feature of much of the quartz at Port Elliot, etc.

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(5) For more detailed descriptions of the mineralogical features, see R. G. Thomas on "A Monazite-bearing Pegmatite near Normanville." Trans. Roy. Soc. S. Austr., vol. xlviii. (1924), pp. 258-268, pls. xxiii., xxiv.

(6) For another view of this subject see C. T. Madigan, "The Geology of the Fleurieu Peninsula, Part I." Trans. Roy. Soc. S. Austr., vol. xlix. (1925), pp. 198-212, pls. xvi.-xx.

IV. GLACIAL FEATURES.

The Hindmarsh Valley.

Standing on the highest point of Granite Island, an excellent view can be obtained of the general outline of the old Palaeozoic valley. To seaward, Seal Island, Wright's Island, and West Island, are ice-smoothed prominences which rise above the water as remnants of the ancient valley to the southward—now submerged. The whole of the sea frontage in the coastal curve, from Port Elliot to the Bluff, consists of low cliffs of morainic material. Between Port Elliot and the mouth of the Hindmarsh River, the cliffs are deeply cut by washouts which, in some cases, have a depth of 20 feet. The walls show fine to coarse sandy deposits, sometimes passing into clays which carry most of the erratics. At the bottom of one of these washouts a large granite boulder was observed and several well-marked glaciated stones were obtained.

Strongly cemented sandstones of glacial origin occur on the beach, as well as indurated sands of Recent age. The former can be distinguished from the latter (1) by their greater solidity, (2) absence of calcareous material, (3) presence of joint planes, (4) difference in weathering, (5) difference in bedding. The glacial deposits pass below sea level. In the same stretch of beach several large granite erratics occur—one measured 12 feet. With the exception of some superficial fluviatile deposits, laid down by the River Inman, these till beds continue to form the shore line quite round to the Bluff.

The eastern boundary of the Hindmarsh Valley is formed by the schists and quartzites of the Adelaide Series which rise with very steep faces abruptly from the valley floor to a height of 800 feet or 900 feet. Two secondary valleys branch off in a north-easterly direction. One a closed valley of glacial material, a mile wide, lies between Brown's Hill and Peeralilla Hill [910 feet]; the other, divided into two by Mount Billy as a central ridge, lies between Peeralilla Hill and the Hindmarsh Tiers, and opens out into the great Nangkita glacial field to the north-eastward. The depth of these valleys cannot be estimated, but they carry the features of U-shaped valleys. The hills maintain an even face towards the valleys and are destitute of spurs. Some have their sides cut by small streams which have a direct course. Peeralilla Hill is particularly steep, which has given rise to land slides that have formed talus terraces in places.

Large granite boulders were observed on the eastern side of the Hindmarsh River in the following situations: in Section 84 (Hd. Goolwa), near the brink of the river; in Sections 117 and 143, between the river and Brown's Hill; two large boulders are perched on the western face of Peeralilla Hill, near the bridge, where glacial sandstones are in the banks of the river; a glacial sandstone is also exposed on Mr. A. Gray's property, near the head of the valley, in Section 59, where it forms a cliff 15 feet high.[7] [For further information concerning the geology of the Hindmarsh River Valley, see (22) Howchin, W., 1898, pp. 12-17.]

An interesting combination of glacial features occurs in the angle of the road where the north road joins that between Port Elliot and Victor Harbour. Within half a mile of the junction, in Section 21 (Hd. Goolwa), and about 200 yards in from the north road, is a group of large erratics. From this point two ice-rounded hillocks *(roches moutonnées)* are seen in the near distance, and the much larger ice-smoothed Crozier's Hill makes a conspicuous object three miles to the westward. The two *roches moutonnées* in the near distance, mentioned above, are on the property of the late Mr. D. H. Cudmore. The most easterly of the two is on the boundary between Sections 20 and 21. It is, perhaps, 100 yards in diameter, perfectly smooth, and is almost bare. The stone is a hard micaceous quartzite [dip S. at 80°], and has been quarried on two sides. There is a granite

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(7) These observations were made before the reservoir was constructed.

boulder, measuring $3\frac{1}{2}$ feet, perched near the top, and two others on the western side of the hill are, respectively, $3\frac{1}{2}$ feet by $2\frac{1}{2}$ feet. In a paddock on the south-eastern side there is a group of 20 boulders measuring up to 5 feet in length.

The second *roche moutonnée*, situated a little to the westward of the one just described, is composed of similar stone and is larger than the other. Mr. Cudmore's residence, "Adair," is built on the western side of the hill. On the northern side of the hill, near the base, is a collection of huge erratics embedded in morainic material—one has an exposed surface 9 feet in length. Between these two dome-shaped rocky hills is a valley of glacial drift which widens out in all directions.

The Inman and the Hindmarsh rivers really occupy the same ancient valley. The two streams have cut their beds in the same great stretch of morainic sands, gravels, and clays which occupy the depression between the Waitpinga highlands on the south and south-west, and the Hindmarsh highlands on the north and north-east. The Hindmarsh Valley ends abruptly at Section 40, on the eastern side of Block A, where the older rocks meet the plain. Above this point the Hindmarsh River flows through a rocky gorge, and at a distance of one and a half miles up, makes a waterfall; and at three-quarters of a mile higher up, the interesting outlier of a fossiliferous Miocene limestone is seen in its banks [(34) Howchin, W., 1911, pp. 55, 56]. This elevated plateau goes by the name of the Hindmarsh Tiers, and makes a curve southwards, as far as Sections 197 and 200, where it ends abruptly in a promontory-like scarp that is locally known as the "Tower of Babel."

The country between the Hindmarsh and the Inman valleys forms a low, broad ridge, the surface of which consists mostly of loose sand and carries a characteristic scrub vegetation. A large granite boulder occurs on the line of fence separating Sections 205 and 218, situated about three-quarters of a mile from the Hindmarsh River. In making the fence it was found necessary to reduce the boulder by blasting, with the result that the portion above ground was shattered into six pieces, the largest of which measures 4 feet by 3 feet, by 3 feet high, leaving the remainder level with the ground in a length of 7 feet.

About midway between the Hindmarsh and Inman rivers there is a saddle-back hill of old rocks, about three-quarters of a mile long, that rises above the glacial beds in Sections 435, 436, and a small portion of 430. One of my students, Mr. J. R. Russell, drew my attention to some glacially-smoothed faces on this exposure. The ridge, which consists of finely laminated quartzite, runs in a roughly north-west and south-east direction, and is a splendid example of a *roche moutonnée* elevation. Many smoothed faces can be recognised, but some of these have lost, through long exposure, their glaze and finer striae. The south-easterly face is bared, and by carefully removing the soil a fine fresh example was obtained, measuring $5\frac{1}{2}$ feet by $4\frac{1}{2}$ feet, which showed high polish and numerous grooves and striae—direction of striae, 20° N. of W. [see pl. viii., fig. 2]. This particular face is on Mr. R. T. Sweetman's property, Section 152, near the angle of Section 435, on the Green Hill Estate, held by Mr. H. M. Parsons. The hill is locally known as the "Stone Hill."

The Inman Valley.

Immediately behind Victor Harbour is a low range of hills which curves round from the River Inman, on the north-western side of the township, to the mouth of the Hindmarsh River. The range is about 60 feet high, and sections of the beds can be seen in road cuttings. The deposits are more or less irregular in the bedding and consist of coarse sands, conglomerates, and bedded sands, with a general dip to the N.W. at 48°. The beds carry abundant pebbles, mostly water worn, and some are ice-marked—facetted and polished or striated. On

the north-western side of the ridge the deposit is more clayey and contains boulders up to $2\frac{1}{2}$ feet in length. One of the latter size is a smoothed example of ilmenite grits. On the western side the ridge is cut by the river where the glacial beds take the form of a freestone (somewhat irregular in hardness) and has been quarried in several places. The stone is much jointed and the joints filled with harder material (probably sand cemented by iron), which gives the joints a darker colour than the body of the stone and causes them to weather in relief. The bedding here, as in the road cuttings, is irregular, but there is a general dip to the N.W. at 20°. In one of the quarries there is an irregular stretch of clay, interbedded with the sands, and in this clay a sharp-edged, irregularly-fractured quartzite occurs, one foot of which is exposed from the matrix. This ridge, which forms part of the great morainic sheet that extends inland almost indefinitely, has been shaped by the River Inman cutting out an extensive terrace on its left bank having a semicircular contour. It is on this ridge that the late Alexander Hay's residence stands [Mount Breckan]. On the slope of the hill, facing the town and not far from the house, there is a considerable field of erratics. About 12 could be counted within one range of sight, the largest measuring 6 feet by 5 feet. Several occur in groups. One erratic possessed sharp angular outlines.

On the western side of the mouth of the Inman (Encounter Bay to the Bluff) the cliffs, which by recent uplift have been placed beyond reach of the waves, contain very large stones sticking out of the clay, while the waste of the cliffs has yielded hundreds of large erratics of great variety that crowd the shore and shallow water in all sizes up to 23 feet in length [(31) Howchin, W., 1910, pls. vii.-ix.].

The Bluff is an ice-contoured headland [Howchin, *loc. cit.*, pls. iii., iv.], 325 feet in height. In the lee of the Bluff a ridge of moraine runs northwards, skirting the slopes of Glastonbury Hill, and passes into the Inman Valley. In its course the paddocks are strewn with large boulders, a group of which, in lineal order, can be seen near the fence at the turn where the main road from Victor Harbour begins to rise in passing over the spur of Glastonbury Hill [Howchin, *loc. cit.*, pls. v., vi.].

The trend of the moraine deposits at the Bluff goes not only northwards but westwards, forming a layer on the top of the cliffs in a breadth of about half a mile, as far as King's Point, the next headland to the Bluff in a south-westerly direction, and at a distance from it of one and a half miles. The ground on the top of the cliffs is dotted with numerous large erratics, as, also, along the shore. The glacial deposits are bordered on the north and west by slaty ridges. King's Point is a typical moraine which, with the ice-smoothed West Island, lying off shore, make a very striking combination of glacial features [Howchin, *loc. cit.*, pls. x.-xvii.].

The Encounter Bay glacial field is limited on its western side by a low range of older rocks which is continuous from the coast to Glastonbury Hill. This ridge was originally covered by the glacial sediments, as patches of moraine and erratics scattered over its surface testify. On the westward side of the ridge the glacial beds are seen again. At their southern end they are separated from King's Point moraine by an interval of older rocks, 20 chains wide; the latter continuing to within a short distance of Newland's Hill, which is included in the glacial area. From here, the glacial sandy country stretches in a westward direction, indefinitely, south of the trig. station "West of Sheaoak Hill," and, according to a local resident, it covers the back country from the coast, practically, all the way to Cape Jervis. In a northward direction, it crosses Hall's Creek in Section 388S. A little to the eastward of this position, in Section 180, and on the north side of the public road, a small outlier of moraine material occurs resting on slates. About 12 large erratics were noted scattered over this patch in an area

of about two acres. Some of these measured 7 feet by 4 feet, and 5 feet by 4 feet, and a group of three or four together covered a space 12 feet by 9 feet. The beds continue in a northerly direction and pass into the main deposits of the Inman Valley.

The road from Victor Harbour crosses the Inman and follows the flats in a westerly direction for a little over a mile, and then takes a rise to Glastonbury Hill. At the sharp turn, groups of erratics, from the Rosetta Head moraine, occur on the left-hand side of the road, as already mentioned, and on rising to the hill the glacial clays are exposed by washouts on the right-hand side. The road crosses the ridge of older rocks near the quarry, and within half a mile it passes within a short distance of the southern end of Crozier's Hill.

Crozier's Hill.

Crozier's Hill makes one of the most conspicuous and striking glacial features of the district [pl. ix., fig. 1]. It is a huge *roche moutonnée*, nearly a mile long and 520 feet in height. The hill is very precipitous on all sides except that to the southward, which latter has a gentle slope. The steepest face is to the north-west, where the hill is suddenly truncated in a craggy and broken scarp that descends precipitously to a dry gap that separates the hill from a glacial sand-ridge, which is continued in a north-westerly direction. From long exposure the hill has lost its definite smoothness, but all the features indicate its glacial origin. It has the general outlines of an ice-smoothed hillock with its gentle slope on the *Stossseite* and its abrupt and craggy face on the *Leeseite* (the crag-and-tail of the British geologists), features which are generally present in ice-worn prominences throughout the district. The hill is surrounded by glacial drifts, and the gap which separates the hill from the glacial sand-ridge in front has not been cut by a creek but by rain-wash acting on the relatively soft material that has been banked up against the sides of the hill, which, probably, at one time was quite covered by the moraine material. Near the base of the scarp a small quarry has been worked, where the stone is a hard siliceous quartzite, having a dip of 25° S. of E. at 50°. Some interbedded thin shales are flexuous. The River Inman flows round the southern extremity and south-eastern face of the hill.

The sandy ridge on the north-western side of Crozier's Hill rises to a height of 200 feet above the level of the Inman. It consists of loose sand at the surface, the grains of which are sharp and sometimes coarse. Towards the top and at the summit of the ridge there is a good deal of rounded gravel, made up of a considerable variety of stones. Large erratics are apparently scarce or absent, as the largest seen was from 2 feet to 3 feet in length. These larger examples consisted of a siliceous quartzite that were probably plucked by the ice in its passage over Crozier's Hill. On the north-eastern side there is another sandy ridge, parallel to the one just described, which has a height of about 300 feet above the bed of the Inman.

The Inman River Beds.

In many places the river has cut its bed down through its own alluvium into the underlying and undisturbed glacial sandstones and clays. In these comparatively soft materials the stream has sculptured deep gutters, caves, grotesque prominences, pot holes, and ridges [(35) Howchin, W., 1918, p. 81, fig. 65], with rapids and small waterfalls at intervals. An excellent illustration of this can be seen just below the junction of Adey's Creek (the chief northern tributary creek) with the River Inman.

A peculiar feature sometimes present in these glacial sandstones is the appearance of large globular masses which weather out from the matrix. Good examples can be seen in the northern bank of the Inman just above the bridge on the road that connects the Inman Valley with the Hindmarsh—the next bridge

below the one at Crossman's Crossing. At the place mentioned there is a considerable exposure of glacial sandstone in the cliffs of the river. The sandstone varies in colour—whitish, yellowish, or reddish—and contains large spherical forms up to several feet in diameter. A zone of imperfectly cemented sandstone generally surrounds the globular mass of harder stone. The surrounding softer material washes away, leaving a ball which is separated from the parent mass by the space of a few inches to a foot. Some have the appearance of large cauldrons placed upside down, the rim of the supposed vessel being carved out at the base. Similar concretionary forms also occur, although less perfectly, in the sandstones of the washouts between the mouth of the Hindmarsh and Port Elliot; also, as rings, on the beach between tide marks at Encounter Bay. They were also noted in a road cutting in similar material on the road between Normanville and Second Valley, close to "Anacotilla," the late residence of Mr. E. C. Kelly. These peculiar formations have attracted the attention of local residents. Those in the Inman, referred to above, are spoken of as "giants' boilers and kettles," and those in the washouts near Port Elliot, were considered to be "fossil pumpkins." The interior of these bodies does not differ much from the matrix in general, the hardening is chiefly confined to the periphery.

Back Valley Creek.

The Back Valley Creek is the longest and most important affluent of the River Inman. It takes its rise on the Mount Desert-Mount Robinson Range which forms the dividing ridge between the Hundreds of Encounter Bay and Waitpinga, and runs, approximately, parallel with the Inman with a slight northeasterly trend. The valley is three miles wide and six miles long, and discharges its water into the Inman on the north-western side of the Aboriginal Reserve, about a mile higher up the valley than Crozier's Hill. The valley consists of sandy and scrubby ridges with lateral creeks at low grades, having flat bottoms and narrow swamps. The surface is monotonous, consisting entirely of glacial or subglacial deposits. Boulders are scarce. Mr. Russell, who had his residence near the head of the valley, stated that he only knew of one such, which was on the top of a low sand-ridge in Section 565, not far from the place where the bore, mentioned below, was put down.

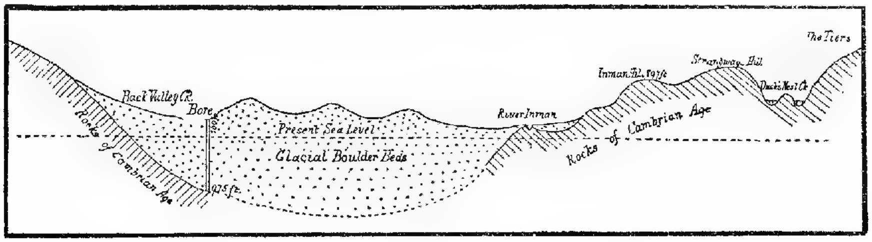

Fig. 3. Geological Section across the Inman Glacial Valley; eight miles.

The chief interest pertaining to this valley is in the Government diamond drill boring for the purpose of testing the country for coal. After two failures, a third attempt, in which the bore was put down near Wilkins' Crossing, at the south-western corner of Section 415 (completed in 1895), reached bed rock at a depth of 964 feet. "From 600 feet downwards the strata consisted of sandstone and boulder formation" [Record of Mines, S. Austr., Fourth Edition, 1908, p. 349]. As already stated, this is the deepest known portion of the Inman Valley and is 800 feet below present sea level.

A ridge separates the Back Valley from the Inman Valley, and was examined on its northern side. Mr. Arthur Mayfield's house is on the public road (Section

266). The sandy hills rise immediately in front of his house on the southern side of the road. In Section 598 there are several large erratics. Three of these in different parts of the paddock measured from 7 feet to 8 feet in length. There are also numerous examples of less size, many of which have been gathered off the land and placed in heaps. The summit, in Section 308, is a rounded hill of hard, laminated quartzite. A public road passes over the summit of the hill in an east and west direction, and on its southern side, in Section 302, a large granite boulder is situated. A great thickness of glacial clay surrounds this inlier of older rocks. Creeks and washouts have cut deeply into the soft flanks of the ridge, suggesting a resemblance, on a small scale, to the "bad lands" of North America; but in no place was it seen that this rain and stream erosion had cut down through the moraine to bed rock.

"Selwyn's Rock" and Neighbourhood.

At seven and a half miles from Victor Harbour, and about half a mile above the bridge that crosses the Inman on the road to Hindmarsh Valley [Section 254], is the historic polished pavement [pl. ix., fig. 2] that for some years became associated with the name of the late A. R. C. Selwyn. In 1897 Prof. T. W. E. David and the writer discovered this rock-face in the bed of the Inman, and as it was the only instance known at that time of such an occurrence in the neighbourhood it was assumed to be the identical glaciated rock reported by Selwyn in 1859, and was at once designated "Selwyn's Rock" [(19) David and Howchin, 1897, p. 61].

Since, then, however, many other similarly polished faces of rock have been discovered in the bed and along the slopes of the river, which raises the question as to which particular one it was that Selwyn discovered. Mr. Joseph J. Crossman, who has lived in the neighbourhood all his life, informed the writer that this exposure could not have been the one that caught the eye of the geologist in 1859. Mr. Crossman's father came into the Inman in 1854. In 1873 he held the land in which the so-called "Selwyn's Rock" is situated. At that time the River Inman had no defined bed, but ran in a series of small waterways which in flood time became a broad stream and had a course nearer to the main road than the present river bed. Drays carting wood passed over the present site of the river. In 1877 the Crossman family cut a ditch to confine the waters. This excavation was made a little lower down the stream than "Selwyn's Rock," but the river cut its way back, up stream, until it reached the bar of rock which carried the polished pavement, and thus the present canyon of the river bed was formed. This disposes of the possibility of the rock referred to being identical with the one mentioned by Selwyn. A much more likely spot for this historic observation made by Selwyn occurs a little higher up the river and will be referred to presently [see p. 105].

The bed of the Inman, being mostly in soft material, local features are constantly changing under the influence of floods. As an illustration of this: In 1897 [*loc. cit.*, David and Howchin] "Selwyn's Rock" was described as "situated on the north side of the stream, within the limits of the flood waters, and passes under a bank of recent river silt. There is a continuous, highly-polished floor, measuring 20 feet by 6 feet, with a surface slightly sloping towards the stream. It is deeply grooved and striated, the striae having a direction of W. $9\frac{1}{2}°$ N., conforming to the general trend of the valley. The stone which has taken the polish is a hard dark-coloured quartzite, very favourable for recording the effects of ice action." When the writer visited the spot in 1910, most of the face, as described above, was covered by the sand of the river bed; but the bank at the back of "Selwyn's Rock" had caved in and exposed an additional piece of the smoothed pavement, 5 feet in length, passing to an unknown extent under the

cover. The face showed two facets of erosion at an angle of several degrees to each other. At the same time, situated about 200 yards lower down the stream than "Selwyn's Rock," another glaciated pavement, 15 yards in length, not previously known, was observed. This face of rock had evidently been previously exposed to the weather, as the polish and striations were dulled and less distinct than the example higher up the river. After having been covered for an unknown period [it was not exposed in 1897] it had recently been uncovered.

The hillsides on the northern side of the Inman, near "Selwyn's Rock," exhibit some remarkable glacial features. A very juvenile creek, which rises in Section 196, flows through Sections 194 and 193. This creek, which has cut deeply into the glacial clay, exposes large granite boulders, and, within recent years, has reached bed rock in the lower part of its course, revealing a succession of polished faces of rock. On the right bank of this creek, and within a quarter of a mile of "Selwyn's Rock," a small rounded hill of older rocks shows above the surface of the glacial sediments, and in the latter extensive washouts have exposed the original glacial floor [Welch's property] [pl. x., figs. 1 and 2; pl. xi., fig. 1]. When this discovery was made in May, 1906, there were parallel washouts having a combined width of 100 yards over all. The highest in position is 100 yards in length; the second, showed an exposed face of 12 yards; and the third, a somewhat smaller one. The rock was very strongly glaciated with striae directed to W. 10° N. According to Mr. Crossman, who was with me, these washouts were started during a heavy rain that occurred five years previously. The exposures in the main creek have occurred since then. [For particulars see (30) Howchin, 1907, p. 268.]

On the rising ground, a little to the north-west of "Selwyn's Rock," there are immense blocks and groups of granite boulders scattered over the sides of the hill, some of which are so massive and closely packed together that they might easily be mistaken for granite rocks *in situ* [pl. xi., fig. 2]. A conspicuous example is a great mass, 17 feet by 10 feet by 13 feet high, enclosed in sandy till in a small creek at the south-west corner of Section 194.

At the next bridge over the Inman, just past the eighth mile-post, a very fine and extensive glacial pavement occurs at a sharp turn in the stream, just above the bridge [pl. xii., fig. 1]. The river cuts in close to the public road from which the outcrop of the older rocks in the river banks is clearly visible. This smoothed pavement was uncovered, in modern times, during a flood in the river in 1913. The present writer had examined this outcrop several times before the date mentioned without suspecting its existence, as the glaciated rock was obscured by a bank of sand laid down on an inner curve of the river. It is almost beyond question that this was the glaciated rock that Selwyn saw. An outcrop of older rocks near the road, in a valley of monotonous sand, was sure to arrest his attention, while the glacial surface can be easily seen from the bridge. The rock is so situated that it must have been repeatedly covered and uncovered by the vagaries of the flood waters, and was most likely exposed to view at the time of Selwyn's journey through the valley. Circumstantial evidence points to this being the genuine SELWYN'S ROCK.

The Upper Inman Valley.

From the bridge, near the eighth mile-post from Victor Harbour, the glacial drift is seen at intervals in the banks of the river [pl. xii., fig. 2]. Between the ninth and tenth mile-posts large granite boulders are extremely common in the Inman, in some places almost choking the bed of the river. One hundred large examples were counted within the distance of a hundred yards. An interesting group occurs in the river bed near Mr. Prouse's [Section 144, pl. xiii., figs. 1

and 2]. One of these, a great monolith, is *in situ* resting on older rocks and surrounded by a strong, sandy till, some of the contained boulders showing glacial striae. The big boulder stands 11 feet high and is 8 feet wide. It has been much larger, as the face next the stream shows recent fractures and scattered around are large fragments that have fallen from the mass. It is said by local residents to owe its present shattered condition through having been struck by lightning. Other masses, measuring 8 feet by 7 feet, are within a few yards of the one just described and smaller examples in profusion. There is also a typical blue boulder clay near the spot containing angular erratics. This galaxy of erratics occurs at the southern extremity of Martin's Hill [see p. 111], where it ends in the river cliffs. The bed rock here is a hard, slightly banded quartzite with a dip south at 50°. The surface, in many places, gives evidence of *roche moutonnée* features. Half a mile higher up the river, near the residence of Mr. A. Mayfield, some excellent exposures of the glacial beds can be seen in the bed of the stream.

At the township of Inman Valley some further interesting features can be studied. On the left bank of the stream, just below the bridge over the Inman [Sec. 269], there is an oblong ridge of the bed rock which shows the usual "crag-and-tail" outline of glaciated hillocks. The slopes on the eastern side (the advancing side of the ice-sheet) show rounded and smoothed surfaces with striae in places; while the western face is steep and broken, giving evidence of having been "plucked" by the ice movement. On the southern slope of the ridge is a deeply scooped-out furrow, 6 feet wide, which, with the striae, shows a direction of 10° N. of W. The northern side of this inlier is entirely obscured by glacial drift. At the bridge this older rock (quartzite) has a dip S.E. at 45°. The large erratic, situated just above the Inman Bridge, that was photographed by Professor David in 1897 [Austr. Assoc. Ad. Sc., vol. vii., 1898, p. 114, pl. iii.], was found by the writer, in 1910, almost covered from sight and a bush of prickly acacia growing on the top of it, with its roots following the joint cracks.

Above the Inman Bridge erratics are particularly plentiful, both in the bed of the river and on either side of the valley, extending for over a mile in width. On the northern side of the river, in Mr. Lush's paddock [Section 326], 50 fairly large granites were counted within a short distance of each other. Two of the largest were photographed. No 1 is a large tabular mass 11 feet by 10 feet by 5½ feet high, surrounded by eight or nine smaller examples [pl. xiv., fig. 1]. No. 2 is pyramidal in shape, 10 feet in diameter and 6 feet in height, tapering towards the top. A still larger example, 13 feet long, but more buried in the moraine material, is situated a little further to the east of those just described.

On the same side of the river there is a high-level patch of glacial clay with erratics on the western side of the Town Hill road. Small boulders occur along the slopes, but near its most northerly limits, in Section 89, at a height above the valley of about 250 feet, and at a distance of about 16 chains to the westward of the Town Hill road, is a large granite boulder 12 feet in diameter and 7 feet out of the ground, with many cast-off fragments around it. The quartz of the granite shows the bluish opalescent colouring, common in the Victor Harbour granite. Within the limits of this high-level patch is a rounded hill of hard quartzite, much broken up, but some of the large slabs of rock still show highly smoothed and polished surfaces.

The highest up granite, of large size, found in the bed of the river (which takes its rise on the eastern slopes of the Bald Hills) occurred near the northerly bend of the stream, in Section 327, and was 6 feet in diameter, and another on the southern side of the road, just over the fence from Section 328.

On the southern side of the Inman, in the same locality, there is also a large field of erratics. In Mr. James Yates' property [Section 413] there are several,

up to 7 and 8 feet in length, spreading into the adjoining sections, where two were measured, one 9 feet in length and the other 12 feet. To the west of these, in Section 319 (Mr. Stone's property), there is a characteristic stony moraine with hundreds of erratics of all sizes up to 8 feet in length. From this point, southwards, the field of erratics can be traced to Mr. Thos. Mayfield's [Section 338], where several large examples were observed.

Strangways Hill and Inman Hill.

In the preceding pages we have confined our attention principally to the glacial features that are seen more immediately in the bed and on the flanks of the River Inman. At higher levels on the northern side of the valley the glacial features are on an equally grand scale. The high plateau that goes under the name of the Hindmarsh Tiers comes to an abrupt termination with a steep and prominent scarp facing the south-east, known as the "Tower of Babel" [see *ante*, p. 100]. Two miles to the westward, Strangways Hill (together with the Inman Hill) form a high precipitous ridge of older rocks that juts out into the valley having an elevation of nearly 1,000 feet. The two projecting headlands (Tower of Babel and Strangways Hill) formed a V-shaped *cul-de-sac* in the path of the glacier, and in this confined space between the headlands some of the most powerful ice-planing was done while large erratics were left behind in great profusion.

The northern boundary of the Inman Valley is much more broken and irregular than the south-western side. The ice-sheet coming in from the southward would meet a formidable barrier in the southern scarps of the Tiers plateau, which it faced diagonally and surmounted. The result was a jagged outline. This is seen in a series of marginal ridges and rounded hills consisting of older rocks. These, beginning with the Strangways and Inman ridge, are continued by the "Stony Hill" and other inliers on Crossman's Road, Martin's Hill, and the low spur, to the westward of Martin's Hill, that comes down almost to the banks of the River Inman.

In approaching this field from the eastward, Mr. Crossman's hut, in Section 122, is situated on a moraine flat with scattered erratics up to 8 feet in diameter. These include a glaciated quartzite 3½ feet in diameter, and, over a slight rise to the southward, amongst several is a fine-grained granite 6 feet by 6 feet by 4 feet high, containing segregations of tourmaline crystals in masses of a black colour, 2 inches up to 5 inches or 6 inches in diameter. A little further to the westward the most remarkable assemblage of granite boulders in the Inman Valley occurs. On Mr. J. J. Crossman's land [Section 122] there are hundreds of these of all sizes up to 20 feet in length, or even more. A ridge of immense erratics occupies the base of Strangways Hill, on its eastern side, where they seem to have been stranded on the recession of the ice-sheet when it was unable to carry them over the steep face of the transverse ridge in its course. Another conspicuous example is a granite mass 17 feet by 10 feet by 13 feet high enclosed in sandy till in a small creek at the south-western corner of Section 194. This field of erratics can be followed to the south end of the Inman Hill where large boulders are seen in the creek in Section 191.

Strangways Hill, together with the Inman Hill, is the most prominent ridge within the Inman Valley. It consists of a hard, thick quartzite which runs out as a spur from the Hindmarsh Tiers in a south-westerly direction, about a mile and a half in length. The ridge is very precipitous and rough on its northwestern side, facing the Duck's Nest Creek, while its south-eastern side is of somewhat lower gradients and has grassy slopes, especially on the eastern or Strangways Hill portion.

The strong quartzite rock of the ridge is connected by a moraine-covered col with the main plateau of the Hindmarsh Tiers, forming an angle with the east and west escarpment of the plateau. In this angle one of the most striking features of the locality is situated in, what is called, the "Falls Gully" [Section 124]. A deep gorge has been cut in the hard quartzite. The present fall is occasioned by the bed rocks exfoliating along the dip slopes at a high angle. The gorge is in two sections. There is a U-shaped valley in its lower end, and a higher, narrow valley at its head. Waterfalls occur at the heads of both the lower and the upper valleys. At the lower waterfall there are two vertical faces of quartzite 150 feet in height. From this height the upper part of the gorge slopes more gradually for another 200 feet before the level of the plateau is reached. The features are very suggestive of a "hung-up" valley retreating by a waterfall.

The outline of the Inman and Strangways ridge is most peculiar. Notwithstanding its prominence it has developed but few water channels. On the south-eastern side a few small and steep watercourses run during torrential rains, but on the north-western side this great scarp has no streamlets, which is evidence of the juvenility of the topographical outlines. The base, on its north-western side, is washed by the Duck's Nest Creek, which will be described at a later stage.

The occurrence of several exposures of the glaciated pavement at the base of Strangways Hill, on its south-eastern side, is of great interest as proving that the ice-sheet took a direct course over this high and steep ridge. The situation is in Section 122, near the apex of the V-shaped valley, mentioned above, and not far from the track. A small runner from a spring has cut through the glacial clay and bared the underlying rock surface. An edge of rock was seen exhibiting striae protruding for an inch or two from under the cover. The glacial clay was carefully removed until a face, 9 feet by 3 feet, was uncovered revealing the tool marks of the glacier in their original features [see pl. xiv., fig. 2]. The position is 350 feet, by aneroid, below the col on the northern side of the main ridge, but faces the highest portions of the ridge. Three other bared portions of the pavement were recognised within 100 yards, the direction of the striae in each case being 20° north of west.

In a small creek near the base of Strangways Hill the stone is a laminated slaty quartzite with a dip W. 10° S. at 57°.

The Inman Hill, which forms the end of the spur towards the Inman Valley has been truncated, benched, and smoothed over in a rounded contour at its southern end.

Duck's Nest Creek.

The Duck's Nest Creek flows through an old ice-eroded valley which until recent times had been choked by moraine material. The creek has, in its upper reaches, followed, mostly, the northern side of the valley where the glacial till abuts on the older rocks of the Tiers plateau. The western and southern sides of the valley are, for most of the way, filled with glacial sands and clay, a section of which, as a finely laminated sandstone, in horizontal layers, can be seen in Section 86. The sides of the old rocks that make the boundary of the original valley are very steep, and the drainage down the sides is undeveloped, features that combine to make a U-shaped valley, which, if cleared of moraine, would be a typical ice-sculptured valley.

The creek, after running a course of about three miles, joins the Inman on the eastern side of the bridge at Crossman's Crossing, and can be best approached from its southern end. With the exception of a few *roches moutonnées,* which it passes in its course, it is in glacial beds from its source until it reaches the southern limits of Section 86, where it enters a narrow gorge that it has cut in a bench of old rocks at the base of the Inman Hill. The walls on the western side are

vertical for about 60 feet, above which the ground slopes upwards to the road leading to Crossman's. At the point where the creek leaves the glacial beds and enters the gorge there is a very large granite boulder near the stream that measures 12 feet by 10 feet, with three other smaller boulders by its side. The stream is comparatively small but is impetuous in flood. The gorge has evidently been cut out by its erosive agency and may be regarded as a gauge by which to estimate the age of the stream.

Going up the creek for a distance of about half a mile—just over the fence into Section 120—a rounded rock of very hard quartzite makes a prominent feature. It is oblong in shape (60 yards in length) with nearly vertical walls in a height of about 18 feet from the lower side of the valley. It is much covered by lichen growths and has suffered some exfoliation by scaling, but its *roche moutonnée* origin is very evident. At one spot on the upper surface, towards the eastern end, a space of about 18 inches square still retained the original polish and striation of the quartzite floor, the striae giving a direction of 20° N. of W. A large granite boulder, measuring 7½ feet by 5 feet, is perched on the top of the rock with several large blocks of similar stone lying by the side which have evidently broken away from the main mass.

Along the same hill face numerous conspicuous boulders occur. One granite example, with inclusions of a metamorphic rock, measured 8 feet by 6½ feet by 7 feet in height; another 8 feet in length, and eight others almost as large. Still further up the valley, a 10-foot example, was nearly obscured by loose material; and another, 16 feet by 10 feet, was much covered by drift and exfoliating [pl. xv., figs. 1 and 2].

When approaching the saddle of the range, a little to the northward of Strangways Hill, laminated quartzite comes near to the surface with a slight cover, in places, of glacial sands. At the saddle the Duck's Nest Creek takes its rise in two branches. The most southerly of the two has a very rocky bed, and near the source is a very fine glaciated face that is 36 feet in length and 6 feet in width which is deeply grooved and striated; direction, W. 5° S. [pl. xvi., fig. 1].

Within a few feet of the top of the saddle are two large boulders resting on each other giving a combined measurement of 7½ feet by 6 feet by 5 feet high. The division between them has probably arisen from fracture, as in the case of "tors" [pl. xvi., fig. 2].

The summit at the head of the Duck's Nest Creek, in the form of a saddle or col, is composed of a remarkable deposit of clay, sand, and stones in an undisturbed condition which has the form of innumerable hills and hollows like graves in an extensive graveyard, locally called the "Bay of Biscay." These curious mounds and depressions, which have a difference of level of from 6 inches to 12 inches, are strikingly suggestive of the "kettle holes" left by retreating glaciers. With reference to these remains Prof. G. F. Wright says:—"We may get some assistance in approximating to a correct chronology of the Glacial Age by studying the smaller kettle holes which constitute so marked a feature in the kames and moraines of the glaciated region. As already shown, the most satisfactory explanation of these curious depressions is, that they mark places where masses of ice were buried in the *débris* of sand and gravel brought down by the streams of the decaying glacier; and where, upon the melting of the buried ice, a cone-shaped depression was left with sides as steeply inclined as the nature of the soil would permit" ["Ice Age in North America," 4th Ed., 1902, p. 471].

From the head of the Duck's Nest Valley an excellent view is obtained of the glacial gutter that has been excavated in the older rocks. The northern faces of both Strangways Hill and Martin's Hill have been sheared by the ice, and the valley, after a course of about four miles and widening out to over two miles, curves round to the southward and joins the main valley.

Crossman's Road and Martin's Hill.

Crossman's Road, which crosses the Inman by a bridge a little beyond the eighth mile-post from Victor Harbour, leads to some of the most interesting glacial features of the district. In the river bed, to the left of the bridge, is the large glaciated pavement already described [p. 105], which is supposed to be the genuine Selwyn's Rock. As the road rises to the ridge, in front, glacial sands and clays are on either side. The Inman Hill is to the right hand and Martin's Hill, at a little distance, to the left. At the first rise in the road, Miss Crossman's new house stands on the outer slope of a rounded rocky knoll, on the left, surrounded by glacial material. A little higher up a similar knoll appears on the opposite side of the road, and a still more conspicuous hill on the western side, which is also rounded in front and ice-plucked on its north-eastern side which from its broken surface is known as the "Stony Hill." At about 100 feet below the summit of the hill is a shoulder of glacial material on which are some large erratics.

In passing over the ridge the scrub on the left hand side of the road contains some very large erratics. The first to attract attention is one situated by the side of the road, set in moraine material, nearly 20 feet in length. Following, at a short distance, is an angular block, 10 feet by 9 feet by 6½ feet, which takes its quadrangular shape by loss of large fragments that have fallen from the parent mass along the joint planes. Other erratics, single or in groups, also occur near the road and many others back from the road. The ice in making the curve between Stony Hill and Martin's Hill seems to have cast off a large number of erratics on the inside of the curve. A group of 16 lie near together, the largest of the group measured 16 feet by 15 feet by 8 feet high, and must have been much larger from the smaller pieces dislodged from it. Another, more on the slope into the gully, in Section 148, was 9 feet by 8 feet by 9 feet high; yet another, deeply sunk in glacial till, 9 feet by 8 feet by 3½ feet high. The largest erratic seen in the Inman Valley occurred here and measured 19 feet by 16 feet by 10 feet high, much exfoliated. The sand and stones on this ridge are much waterworn, but many of the pebbles have been subsequently polished, striated, or soled by ice action. The latter include white and black quartz, quartzites, and a variety of igneous rocks.

The descent on the northern side of the ridge is into a valley which is in line with the upper portions of the Duck's Nest Creek, but has been forsaken by the latter. It is evident that this was the original course of the stream and that its sudden diversion from a westerly course to a southerly one has been by capture. The main valley still continues in a westerly direction, the Grey Spur Range forming its northern boundary and Martin's Hill the southern. In this valley, about midway between the Grey Spur and Martin's Hill, Mr. Crossman has his house and property [Section 404]. A large erratic can be seen in a small swamp situated on the south-eastern side of Mr. Crossman's house.

The white sand and clay, seen on the road that passes over the ridge, is continued into the valley. The Deep (or Freshwater) Creek which comes into the valley by the Grey Spur carries on the drainage and has modified the valley floor to some extent by a rearrangement of the morainic material. In Section 361, this creek makes a sharp turn, or horseshoe, to the south and has cut into the undisturbed till beds. The bottom of the creek exposes yellow, grey, and white clays with sands, in which the stream has cut ruts and pot holes, and on one side is a cliff of glacial beds 20 feet in height. The clays are irregularly deposited in heaps and vertical bands and carry a few erratics.

Martin's Hill is a ridge of quartzite that has a direction north-east to south-west, closely parallel with the Strangways and Inman ridge. It occupies nearly the whole of Section 145 and is about one and a half miles in length. This ridge

would be in the direct course of a glacier going down the Duck's Nest Valley and would have the effect of dividing the ice-flow in its deeper portions into two streams, one going over the shoulder of the Stony Hill, on Crossman's Road, into the Inman Valley, and the other, swinging round the western flanks of Martin's Hill, would join the main valley higher up.

The northern side of Martin's Hill, near the summit, has been strongly glaciated which has left the upper portions rounded and smoothed. No clear evidence of striation could be detected, probably the result of weathering from long exposure. The hill, by aneroid, is 200 feet above Mr. Crossman's house in the valley below. The northern slopes of the hill are banked up with moraine which extends across the valley to the opposite ranges. Drainage along the slope has cut deeply into the material and developed transverse ridges and flats. Where clay has been laid bare the ground is swampy.

Further along the valley, going westwardly, the moraine forms a long grassy ridge on the southern side of the creek, and a spur of the older rocks, in the form of slates and argillaceous quartzites, crosses the valley from the northward, with scores of large granite erratics besides numberless small ones. This locality is most conveniently approached from the southward, by Adey's Creek, the chief affluent of the River Inman, coming in from the north, which joins the latter a little to the eastward of the Inman Valley township. Adey's Creek is in glacial clay with broad river flats at the surface. On the eastern side are well-grassed hills having phyllites with a sericitic sheen on their planes, as bed rock [dip S.E. at 30°], which is covered with a thick chocolate-coloured soil and subsoil of stiff glacial clay. In places, the slaty rock is calcareous, and on top of the ridge there is a thick limestone crust which is burnt for lime. This slaty country slopes down to the "Deep Creek," near where the latter, coming in from the east, junctions with Adey's Creek. In Sections 273 and 76, on the south-eastern portion of this ridge, facing to the glacial valley that was eroded on the north-western side of Martin's Hill, is the important trend of erratics mentioned above. These occur in places in groups from 10 to 20 near together and up to 7 feet or 8 feet in length. The largest single erratic was 18 feet in length and only partially exposed. The lower part of this trend is just below the District Council's quarry, in Section 76. The lower part of the ridge, on the south-eastern side, shows a somewhat stronger stone, approaching a quartzite.

For description of beds to the westward of Adey's Creek see p. 105—"Upper Inman Valley."

Bald Hills Water Parting.

The Bald Hills, situated about 15 miles from Victor Harbour, on the one side, and seven miles from Normanville, on the other, form the water parting between the sea coasts on either side of the Fleurieu (Cape Jervis) Peninsula. The Rivers Inman and Hindmarsh with their tributaries drain the country to the eastward, and the Bungala and Yankalilla Creeks to the westward. The main road crosses the watershed at a height of 640 feet (aneroid) above sea level. The deeper portions of the old glacier valley lay more to the eastward, while the Bald Hills formed a high-level rocky ridge that crossed the valley transversely but was over-ridden by the ice-sheet. The Bald Hills watershed is still, in the main, a ridge of moraine material through which the older rocks are exposed in places. The old glacial slopes are steep and the moraine deposits abut against the sides of the glacial valley walls in an approximately horizontal position.

Here, as elsewhere in the district, wherever there is a moderate slope of the surface, washouts in the glacial beds are common and are a source of trouble to the owners of the land. On Miss Mayfield's grounds (Section 348) there is one of these a third of a mile long, 60 feet deep, and 3 chains wide. It had not yet reached bed rock. Similar deep washouts occur in the surrounding paddocks.

There is a general resemblance between them in having white sandy clay in their upper layers, washed and sliding material on the lower slopes, and, near the bottom, undisturbed clay with stones, varied by gritty sandstones, sometimes irregularly stratified with clay bands.

Near the summit of the Bald Hills a ridge road goes northward to Mr. Arnold Mayfield's. The country on both sides is covered by glacial drift with occasional granite boulders, and, on the westward side, a very large washout occurs. A creek towards the ranges was followed. Numerous large granite erratics, up to 9 feet in length, were scattered over the sides of the hills and in the creeks. The Archaean rocks are exposed in a creek near the base of the range and also on side of the hill. The rock is very complex—gneissic, quartzitic, aplitic, schistose, etc., and weathers irregularly.

Much of the country on the Bald Hills ridge, especially on the high ground, is covered with a dark, almost black, tenacious clay soil. This feature attracted the attention of Selwyn [Austr. Assoc. Ad. Sc., vol. vii., 1898, p. 119], who supposed that it had resulted from the decomposition of crystalline limestones associated with hornblendic and micaceous rocks. This, however, is not likely, as no such rocks are known to occur in the neighbourhood. The black soil is probably the remains of old swampy ground before the valleys became so deeply incised as at present. Glacial country in the swamp stage can be found covering wide areas around Mount Compass, on the Hindmarsh Tiers, and in the Myponga district.

Westward of the Bald Hills.

That the ice crossed the barrier of the Bald Hills, in its passage westward, is abundantly evident not only from the thick deposits of drift and glaciated stones that occur on the summit of the ridge, but also by the glaciated contours, and, in some cases, polished and striated rock surfaces that occur on the western flanks of the watershed. Near the summit of the ridge a small inlier of the older rocks is exposed by the cutting down of a valley in Section 356 (Hd. Encounter Bay), situated on the southern side of the road near the western boundary of the hundred. On the Yankalilla side of the boundary a similar outlier is seen in Section 1606 (Hd. Yankalilla), on the northern banks of the River Yankalilla, also another in Section 385, and in the adjoining Section, No. 384, an outcrop is seen under the bridge on the district road which unites with the main road near Mr. Edward Mayfield's (late Stevens) house. Near the same house is a cutting on the public road exposing glacial till with erratics.

An interesting group of erratics occurs near the main road a little to the eastward of Mr. Ed. Mayfield's (Section 384). The erratics in this case, and some others in the neighbourhood, differ somewhat from the Inman Valley type and are of a more varied character, having a lithological resemblance to the greatly altered rocks that form the cliffs near the Little Gorge on the Second Valley road. There is a direct connection by glacial drift and erratics between the two points, and it might be that an easterly curve of the major glacier of the Gulf Valley swept the flanks of the Bald Hills; or, possibly, the curve came in from the north sweeping the flanks of the Moon and Kemmiss Range where similar rocks occur. I gathered from the spot about a dozen glaciated stones, including gneisses, aplites, and dark-coloured quartzites similar to the stone quarried on Glastonbury Hill.

A little to the south-eastward of the group just described is a large boulder of granite on Mr. Nosworthy's land which measures 9 feet by 5 feet 9 inches by 3 feet high. A little further to the southward, in Section 368, in Mr. George Mitchell's ground, is another granite erratic, showing above ground 12 feet by 10 feet by 4 feet high, but as it is wider below it is probably much larger. It has given the name of the "one-stone paddock" to the field in which it occurs.

On the northern side of the main road, in Section 383, there is a wash out with two conspicuous erratics.

A little lower down the western slope, two polished rock surfaces, a foot or two square, have been cleared of the overlying glacial drift by a small head-water stream of the River Bungala, situated not far from the public road. The pavement is a hard, dark-coloured, siliceous quartzite, the striae have a direction W. 24° N. [Glac. Res. Com., Austr. Assoc. Ad. Sc., vol. vii., 1898, p. 120].

The most important inlier of the older rocks on the western side of the Bald Hills is a large, almost circular and rounded hill, known as Cockatoo Hill. It extends from the main road, in Section 387, almost to Torrens Vale (or Dairy Flat); the branch road to the latter place goes round the base of the hill. It has the usual crag-and-tail outline of the glaciated hills of the district, with a precipitous face towards the west. The opposite or sloping side is obscured by drift. The scarp face carries a remarkable excavation of semicircular outline that is strongly suggestive of a cirque. There is nothing in its present surroundings to account for its existence, as there is no drainage that might have caused a retreating waterfall. It appears to be a glacial feature caused by the plucking and sapping produced by ice movement acting on a high and steep ridge, probably in the later stages of the glaciation.

The ancient ice-filled valley, after passing the Bald Hills, opened out considerably. The main flat was in the direction of Normanville, and from this the ice-sheet spread to the westward, in the direction of the present gulf, with branches to the northward and southward. In this low country the Rivers Bungala and Yankalilla have removed, or covered, much of the glacial drift and built up extensive flood plains over the area. The Bungala, near Yankalilla, has entrenched its bed from 15 feet to 20 feet, which has been accomplished since the settlement of the district. Near the river the glacial beds are obscured by newer sediments, but on the higher ground they can be seen in many places, sometimes under considerable erosion.

Near the confluence of Wood's Creek with the River Bungala, about three-quarters of a mile from the township of Yankalilla, the glacial sandstones outcrop in the creek at the bridge on the Inman Valley road. Also, a short distance up the creek there is an old Government quarry in the glacial sandstone that has been long worked for road metal. The quarry face is 150 yards wide and 50 feet in height. The stone is a white, yellow, and grey sandstone that decomposes at the surface but, at depth, is a compact grit-stone, as shown in sections under the microscope. The bedding is indistinct but the stone is strongly jointed and crowded with erratics of great variety; the largest seen was a granite boulder, 18 inches by 10 inches. Some of the granites contained the opalescent variety of quartz which seems to indicate their origin as having come from the Port Elliot district. The glacial beds rest unconformably on the syenite which is the bed rock of the neighbourhood. No glaciated surface could be detected on this rock.

The hill facing Yankalilla on the northern side is capped by a loose white sand. In places, on the slopes and also on the hill road on the summit of the ridge, moderately hard red and white glacial sandstone crops out and follows the main road to Myponga. Going west, the Cambrian limestones outcrop on the northern side of Section 1031, and these are covered on the western, southern, and south-eastern sides by disintegrated glacial material. In Section 1019 (facing the beach road) the glacial sandstone has been quarried in two places. On the northern side of Yankalilla and Normanville glacial deposits can be seen in most of the creeks and also in the valleys intersecting the Cambrian limestones. Several washouts in these beds occur in the valley slopes.

The country to the southward of Yankalilla, for some miles, is chiefly composed of glacial drift. Approaching Mount Robinson from Miss Mayfield's (Section 348, Hd. Encounter Bay), on the southern side of the Bald Hills, the ground continues sandy over the intervening rise and up to the lower slopes of the mount. The same class of country continues to Torrens Vale and Hay Flat and down to the main road on the eastern side of the Little Gorge. In Section 1103 (Hd. Yankalilla) there is a washout in the glacial beds three-quarters of a mile long and 30 feet deep, with hard sandstone at bottom and clay sides. In the latter, erratics of various sizes occur, one of which, a granite boulder, measured 3 feet 6 inches.

Second Valley and Rapid Bay.

The main road between the Little Gorge and Rapid Bay passes through several cuttings in glacial clay. About nine miles from Yankalilla and one mile to the southward of Mr. E. E. Kelly's (Anacotilla) water-trough is a clay bank with erratics. One of the latter, a subangular red-coloured quartzite, highly polished and striated, measuring 18 inches by 11 inches, was secured. On the southern side of Fowle's Hill, just past the 59-mile post from Adelaide (13 miles from Yankalilla), a section of glacial drift with striated pebbles is seen in the road cutting, near top of hill. The glacial clay occurs as a pocket in a depression in calcareous shales and extends for 33 yards and is 12 feet high with base not exposed. Erratics are numerous, a striated greenish quartzite measured 12 inches by 6 inches.

From near the coast, at Second Valley, to the marble knob near the hotel, the superficial beds are glacial drifts exposed in washouts. In the western angle of Section 1568, near the old district road parallel with the coast, are two large boulders, one, a granite, 3 feet by 2½ feet, and a rounded boulder of smooth dolomitic limestone 2 feet in diameter. The glacial clay passes over the saddle into Poole's Flat, where there is an extensive washout containing striated pebbles, which continues to the slope of the hills on the eastern side, with more washouts. The washouts on the northern side contain many large erratics, chiefly granites and quartzites. On the road to Rapid Bay, a patch of glacial moraine occupies a coastal valley up to a mile from the beach. At about that distance from the beach a group of granite boulders occurs by the side of the road. The largest gave a measurement of 6 feet by 4½ feet above the surface. Nearly opposite Mr. Crozier's gate another group occurs, on rising ground. One granite boulder, 5 feet by 4 feet, was of a different type from the Victor Harbour granite. The group also included several large quartzite erratics that were foreign to the locality in which they occur. Speaking generally of the Second Valley district, the valleys are choked with glacial waste while the greater heights have been cleared of such.

For a description of the glacial features of Cape Jervis, see Howchin, Glacial Report, Austr. Assoc. Ad. Sc., vol. vii., 1898, p. 124.

GENERAL REMARKS.

The Form of Glaciation. The ice-flood within the area herein described was exclusively terrestrial in its form. This is apparent, not only from the absence of marine or lacustrine sediments that might suggest floating ice, but the continuous *roche moutonnée* surface of the floor over which it moved is definite proof.

The Direction of the Ice-flow. The following observations in relation to the direction of the striae with reference to magnetic north may be quoted:—

The Stone Hill (Sweetman's, situated on the low ridge between the Hindmarsh and Inman Valleys)	W. 20° N.
At base of Strangways Hill, on south-eastern side	W. 20° N.
The col, at the head of Duck's Nest Creek	W. 5° S.
Roche moutonnée, near angle of Duck's Nest Creek ..	W. 20° N.
"Selwyn's Rock" (as first named)	W. 9½° N.
Welch's washout, near to the last-named (Section 193) ..	W. 10° N.
Inman Valley Bridge	W. 10° N.
Western side of the Bald Hills	W. 24° N.

The extreme range in direction amounts to 29°. If the apparently aberrant reading at the head of the Duck's Nest Creek be eliminated the range is between 9½° and 20°, or about 10°, which in the case of a wide valley, with strong diversity in relief, is a remarkably uniform reading. The direction of the striae at Hallett's Cove may be given, for comparison, as follows:—On the purple slates at Black Point the main direction is N.W. with a few intersecting striations that have a more northerly trend; at Tate's Rock the direction is N. 20° W., and the same direction is maintained on quartzite, a little further to the north, on both sides of the rocky creek in that direction, supported by five distinct readings. Considering the distance separating the Inman Valley and Hallett's Cove and the somewhat different directions of the respective valleys, the close agreement in the readings from the two localities is remarkable.

The Source of the Ice-sheet.—In South Australia the trend was, practically, included within the quadrant between west and north. In Victoria, in the Bacchus Marsh district, the glacial striae have a direction from S.W. to N.E. [Sweet and Brittlebank, Austr. Assoc. Adv. Sc., vol. v., 1893, p. 378]. A similar direction is indicated at Wynyard, Tasmania, *viz.*, from S. 30° W. towards N. 30° E. [David, Austr. Assoc. Ad. Sc., vol. xi., 1907, p. 277]. These respective readings point, conjointly, to a region to the southward, somewhere in mid-distance between the extremes of the localities mentioned, as the centre of radiation. We may assume that this was to the south-westward of Tasmania, and included the eastern slopes of Jeffrey's Deep, an extraordinary sunken area that is now, at its deepest part, nearly four miles below the normal level of the ocean floor. The foundering of this part of the ocean bed, extending from the western shores of Tasmania to Albany, may stand related to the submergence of that part of the Australian continent which, in Permo-Carboniferous times, was the centre of dispersion of the ice-flood that overspread the southern portions of the continent.

The Thickness of the Ice. It is only when the original surface contours of a glaciated country have been preserved that any evidences are available for estimating the probable thickness of the ice-sheet. South Australia, by reason of the preservation within its limits of the topographical features that existed at the time when the glaciation occurred, as already explained, has the advantage in this respect. The glacial floor in the Inman Valley at its greatest known depth (obtained by boring in the Back Valley Creek) is 800 feet below present sea level. At Kingscote, Kangaroo Island, the floor was reached at 1,000 feet below present sea level. These figures indicate that at the time of glaciation the land stood considerably above its present elevation.

The full depth to the glacial floor, as proved by the Back Valley Creek Bore, is 964 feet. The Inman Hill is 897 feet above sea level, while the adjoining Strangways Hill, is somewhat higher. The Bald Hills are probably somewhat lower. Glaciation has been observed either to the summit, or nearly so, on all these heights. Estimating that the Back Valley Creek Bore is about 200 feet above sea level, to allow of the ice-sheet overwhelming the surrounding heights of the

valley, it must have been something like 1,700 feet, at least, in thickness. There were, apparently, no heights within the region that rose above this ice level, so that the latter must have been more than a mere local valley glacier, and can only be described as a true ice-cap, such as at present occurs within the Arctic and Antarctic circles. To supply such an enormous ice-flood would require an adequate gathering ground and an elevation sufficient to maintain a gravitational force equal to the over-riding of no inconsiderable hills in its course.

The Erratics. As is usual with most glaciers of a terrestrial kind, the erratics are, largely, of a relatively local origin. By far the largest number of erratics in the Inman Valley district have been ploughed from the granitic zone bordering the coast. Close to the Bluff they exhibit a more diversified character having been transported from a region further to the south, now submerged. In inland situations, such as Hallett's Cove, whilst some conspicuous examples are far travelled, others have been plucked from localities near at hand, including very large blocks of impure limestone, quartzites, the Sturtian tillite, and Tapley's Hill slates, which are found *in situ* in the neighbourhood of the Onkaparinga River. An interesting field of enquiry is awaiting workers in the petrographical description of the erratics in relation to their origin, and particularly such as occur on the immediate seaboard which, it may be expected, would give interesting evidence bearing on the nature of the rocks that are submerged to the southward.

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GEOLOGICAL MAP OF THE INMAN VALLEY AND NEIGHBOURHOOD.

By Professor Walter Howchin, F.G.S.

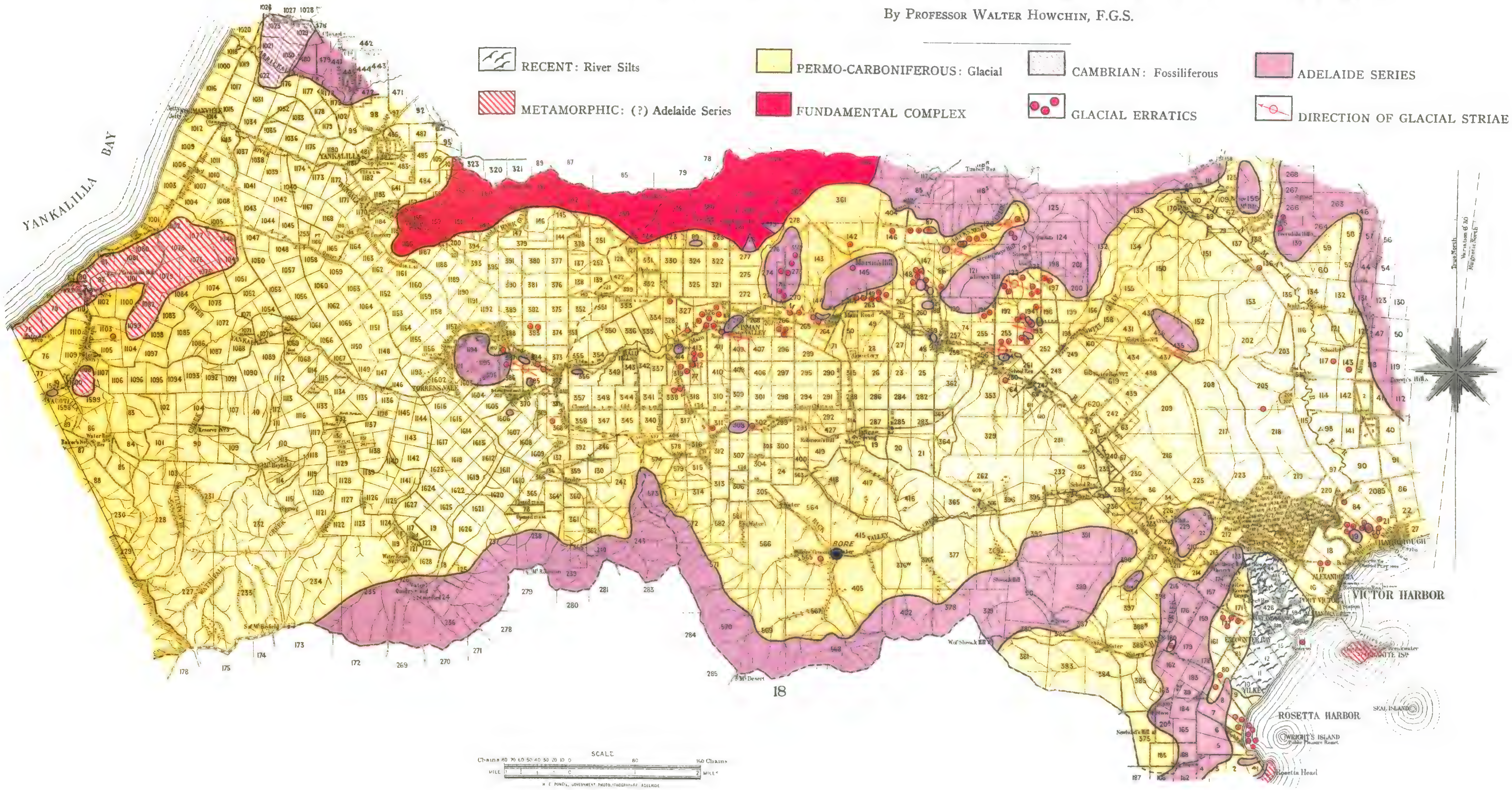

Fig. 1. View of the "Grey Spur."

Fig. 2. Glaciated Floor (Sweetman's) between the Hindmarsh and Inman Rivers.

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Fig. 1. Crozier's Hill: a great *roche moutonnée.*

Fig. 2. Glaciated Floor in the Inman River. The first-named "Selwyn's Rock."

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Fig. 1. Glaciated Floor exposed in Webb's "Washout."

Fig. 2. Glaciated Floor as in fig. 1. Near view of portion.

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Fig. 1. Glaciated Floor as in pl. x. Near view showing ricochetting.

Fig. 2. Group of large granite Boulders near [illegible]

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Fig. 1. Glaciated Floor in the Inman River described by Selwyn.

Fig. 2. Section of undisturbed Boulder Clay in bed of the Inman River.

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Fig. 1. Large erratics resting on glaciated sandstone in the Inman River.

Fig. 2. A large group of Erratics in bed of Inman River.

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Fig. 1. Large boulder in Mr. [illegible]'s paddock.

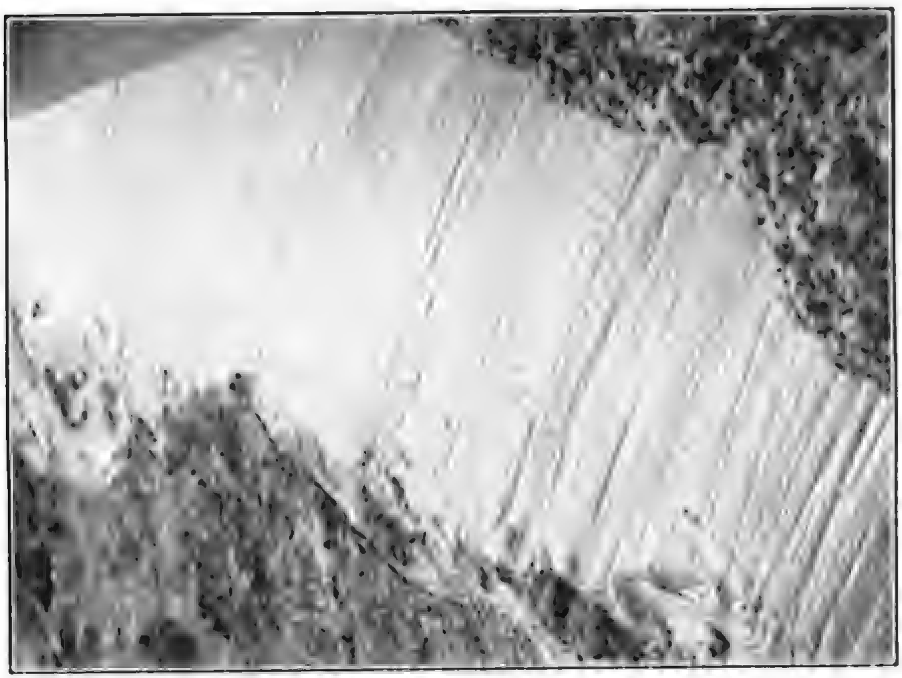

Fig. 2. Strongly striated Glacial Floor at the base of Strangway's Hill.

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Fig. 1. Great thickness of Tillite in Duck's Nest Creek.
Note presence of Erratics on ridge.

Fig. 2. Near view of Erratics seen on top of ridge in fig. 1.

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Fig. 1. Glaciated Floor near the head of Duck's Nest Creek.

Fig. 2. Two large granite Erratics on summit of col behind Strangway's Hill.

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DESCRIPTION OF PLATES VII. TO XVI.

PLATE VII.

Geological Map of the Inman Valley and Neighbourhood.

PLATE VIII.

Fig. 1. View of the "Grey Spur." Photo. W. Howchin.

Fig. 2. Glaciated Floor (Sweetman's) on ridge between the Hindmarsh and Inman Rivers. Photo. W. Howchin.

PLATE IX.

Fig. 1. Crozier's Hill: a great *roche moutonnée.* Illustrates the "Crag-and-tail" outline of glaciated hillocks. Photo. W. Howchin.

Fig. 2. Glaciated Floor in bed of the Inman River. The first-named "Selwyn's Rock." Photo. T. W. E. David.

PLATE X.

Fig. 1. Glaciated Floor exposed in Welch's "Washout." General view. Photo. W. Howchin.

Fig. 2. Glaciated Floor as in fig. 1. Near view of portion. Photo. F. Noetling.

PLATE XI.

Fig. 1. Glaciated Floor as in pl. x. Near view showing ricochetting in glacier movement. Photo. F. Noetling.

Fig. 2. Group of large granite Erratics near Welch's "Washout." Photo. J. Greenlees.

PLATE XII.

Fig. 1. Glaciated Floor in bed of the Inman River, supposed to be the one described by Selwyn. Photo. W. Howchin.

Fig. 2. Section of undisturbed Boulder Clay in bed of the Inman River. Photo. W. Howchin.

PLATE XIII.

Fig. 1. Large Erratics resting on glacial sandstone in the bed of the Inman River, near Mr. Prouse's. Photo. W. Howchin.

Fig. 2. A large group of Erratics in bed of the Inman River, near Mr. Prouse's. Photo. J. Greenlees.

PLATE XIV.

Fig. 1. Large Erratic in Mr. Lush's paddock. Photo. W. Howchin.

Fig. 2. Strongly striated Glacial Floor at the base of Strangways Hill. Photo. W. Howchin.

PLATE XV.

Fig. 1. Great thickness of Tillite in Duck's Nest Creek. Note the presence of Erratics near top of ridge. Photo. W. Howchin.

Fig. 2. Near view of Erratics seen on top of ridge in fig. 1. Photo. W. Howchin.

PLATE XVI.

Fig. 1. Glaciated Floor near the head of Duck's Nest Creek. Photo. W. Howchin.

Fig. 2. Two large granite Erratics on summit of col behind Strangways Hill. Photo. W. Howchin.

SOME REFERENCES TO THE LITERATURE CONCERNING THE EXTINCT EMUS OF KANGAROO ISLAND AND ELSEWHERE.

By PROFESSOR WALTER HOWCHIN, F.G.S.

[Read April 8, 1926.]

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STUDIES IN AUSTRALIAN LEPIDOPTERA.

By A. Jefferis Turner, M.D., F.E.S.

[Read June 10, 1926.]

Fam. ARCTIADAE.

Phaos aglaophara, n. sp.

ἀγλαοφαρος, in splendid apparel.

♂, 34-38 mm. Head blackish; centre of face whitish. Palpi blackish. Antennae blackish; pectinations in male $1\frac{1}{2}$. Thorax blackish, anterior margin and edges of patagia whitish. Abdomen on dorsum crimson, with a blackish median band interrupted on apical segments; tuft ochreous; underside whitish barred with dark fuscous. Legs whitish; anterior tibiae and tarsi dark fuscous on inner surface; femora crimson on dorsum; posterior tibiae without middle spurs. Forewings elongate-triangular, costa straight, sinuate towards apex, apex rounded, termen bowed, oblique; orange-ochreous, paler on margins and veins: a crimson subcostal streak from base to $\frac{1}{4}$; costal edge whitish-ochreous; a basal dorsal spot, and larger, triangular, subbasal, median spot, blackish; an outwardly curved, broad, blackish line from $\frac{1}{4}$ costa to $\frac{1}{4}$ tornus; a large, somewhat reniform, blackish, discal spot beyond middle, connected with costa; a blackish line from mid-dorsum obliquely outwards to beyond lower part of discal spot; a blackish terminal band containing eight longitudinal whitish bars; cilia blackish, apices partly whitish. Hindwings broad, termen gently rounded; 4 and 5 separate; orange; extreme base, a large diamond-shaped discal spot, and a terminal band blackish; cilia whitish, bases blackish, on dorsum orange. Underside orange; forewings with a crimson subcostal streak from base to $\frac{1}{4}$; discal spot and terminal band on both wings blackish, band on forewings barred with whitish.

Nearly allied to two Tasmanian species, but certainly distinct.

New South Wales: Mount Kosciusko (5,000 to 6,000 feet), in December and January; five specimens received from Dr. G. A. Waterhouse and Mr. G. M. Goldfinch.

Fam. NOCTUIDAE.

Agrotis poliophaea, n. sp.

πολιοφαιος, dark grey.

♂, 38 mm. Head, palpi, and thorax grey with some fuscous and whitish scales. Antennae fuscous; pectinations in male 2, apical $\frac{1}{3}$ simple. Abdomen grey, becoming fuscous towards apex. Legs fuscous; tibiae and tarsi annulated with whitish. Forewings elongate-triangular, costa straight, apex rounded-rectangular, termen slightly sinuate, slightly wavy, not oblique; grey; a large, grey-whitish, subdorsal spot near base, its anterior and posterior edge blackish; dark-fuscous costal dots near base, at $\frac{1}{3}$ and $\frac{2}{3}$; claviform faintly indicated by a very slender blackish loop; orbicular grey-whitish, longitudinally oval; reniform larger, kidney-shaped, grey-whitish, partially and very slenderly outlined with blackish; a slightly dentate, doubly sinuate line from third costal dot to dorsum at $\frac{3}{4}$, curved outwards in middle, inwards above dorsum; ground-colour beyond this line paler; a fine, blackish, terminal line, into which run very short, blackish, inter-neural streaks; cilia grey-whitish with two pale fuscous lines, bases brownish tinged. Hindwings with termen sinuate, wavy; fuscous-grey; veins fuscous; cilia whitish with a pale fuscous antemedian line.

Nearest *A. poliotis,* Hmps., but darker, especially the hindwings, which in that species are nearly white.

Western Australia: Merredin; one specimen received from Mr. L. J. Newman.

Caradrina loxosema.

Proteuxoa loxosema, Turn., Trans. Roy. Soc. S. Austr., 1908, p. 55.
Ariathisa ophiosema, Turn., Annals Q'land Mus., x., p. 66 (1911).

These appear to be the same species. There is some variability in colour and markings. I can find no spine on posterior tibiae, and probably mistook some hair-scale for a spine.

Victoria: Melbourne, Wandin, Gisborne.

Sarrothripus indica.

Sarrothripa indica, Feld., Reise Novara, pl. 106, f. 19 (1874).
Cletthara pallescens, Hmps., Ill. Heteroc., Brit. Mus., ix., p. 108, pl. 163, f. 25 (1893).
Sarrothripus symmicta, Turn., Proc. Linn. Soc. N.S. Wales, 1902, p. 92.
Sarrothripus abstrusa, Turn., *l.c.*, 1909, p. 344.

Species of this genus are often very variable, and I believe that these are all forms of one species. The ground-colour varies from grey to brown, and dark blotches, dots, or spots are frequently developed on forewings, sometimes a dark line on submedian fold connects the antemedian and postmedian transverse lines. I have now a good series for comparison.

North Queensland: Cairns, Herberton. Queensland: Yeppoon, Gayndah, Brisbane, Mount Tambourine, National Park (3,000-3,500 feet), Toowoomba. New South Wales: Lismore, Port Macquarie. Also from Malay Peninsula and Ceylon.

Gen. **Hypolispa,** nov.

ὑπολισπος, somewhat smooth.

Frons flat. Tongue strong. Palpi slender, upturned, not reaching vertex, smooth-scaled; terminal joint short. Thorax smooth-scaled; a small, bifid, posterior crest; smooth-scaled beneath. Abdomen with small dorsal crests on first three segments. Posterior tibiae smooth. Forewings with 2 from $\frac{3}{5}$, areole small and short, 10 approximated to 8, 9 at origin. Hindwings with cell $\frac{1}{2}$, 3 and 4 connate from angle, 5 approximated to them at base, 6 and 7 connate, 12 anastomosing with cell to middle.

Near *Bryophilopsis,* Hmps., which has the areole long, and two small median crests on thorax.

Hypolispa leucopolia, n. sp.

λευκοπολιος, whitish-grey.

♀, 28 mm. Head, palpi, and thorax whitish-grey with a few dark-fuscous scales. Antennae fuscous. Abdomen whitish-grey. Legs whitish; anterior tarsi fuscous with whitish annulations. Forewings elongate-triangular, costa slightly arched near base, thence straight, apex rectangular, termen bowed, scarcely oblique; whitish-grey, more whitish towards costa; a short, oblique, blackish streak from costa at $\frac{1}{4}$, sometimes connected by a fine line from its apex with a very small, irregular blackish mark about middle, on lower edge of cell; reniform whitish-grey, kidney-shaped, surrounded by a whitish suffusion; cilia pale grey. Hindwings with termen rounded; white; some of the veins and a narrow terminal suffusion fuscous; cilia white.

Queensland: Yeppoon, in October; one specimen.

Fam. LARENTIADAE.

Horisme cristata.

Coremia cristata, Wlk., Cat. Brit. Mus., xxxv., p. 1683.
Cidaria decreta, Wlk., *ibid,* p. 1692.
Encymatoge peplodes, Turn., Proc. Roy. Soc. Vict., 1903, p. 247.

I am indebted to Mr. L. B. Prout for the identification of Walker's types.

North Queensland: Eungella. Queensland: Caloundra, Brisbane, Toowoomba, Roma, Warwick, Stanthorpe. New South Wales: Mittagong. Western Australia: Geraldton.

Melitulias oriadelpha, n. sp.

ὀρειαδελφος, a mountain brother.

♂, ♀, 28-32 mm. Head, thorax, and abdomen fuscous. Palpi in male $2\frac{1}{2}$, in female 3; fuscous, towards base beneath white. Antennae fuscous; in male simple, ciliations minute. Legs fuscous; tarsi slenderly annulated with whitish. Forewings broadly triangular, costa nearly straight, slightly arched before apex, apex pointed, termen bowed, oblique, wavy; a fuscous basal patch, outer edge, sharply defined, wavy, from $\frac{1}{4}$ costa to $\frac{1}{4}$ dorsum; there follows this a brownish-white transverse fascia, containing two fine darker lines, infuscated on costa; central band moderate, grey, with three anterior and three posterior wavy transverse lines and a median discal dot fuscous; anterior edge wavy, from $\frac{2}{5}$ costa to $\frac{2}{5}$ dorsum; posterior edge from $\frac{4}{5}$ costa to $\frac{4}{5}$ dorsum, wavy, slightly more prominent beneath costa and above middle; there follows a brown-whitish band, infuscated towards costa, containing four fine darker lines; a narrow grey terminal fascia; a fuscous terminal line; cilia pale grey with a darker median line. Hindwings with termen rounded, crenulate in female only; grey; in male with a small, oval, whitish spot of altered scales just before middle; cilia grey. Underside of forewings grey with a fuscous discal dot on end of cell; of hindwings grey with a discal dot at $\frac{1}{3}$, and three rows of minute dots on veins beyond middle, fuscous.

Very like *M. glandulata,* but the discal mark on hindwings of male is much smaller. It also differs in the discal dot on underside of forewings, and the sexes are much more similar than in that species.

New South Wales: Mount Kosciusko (5,000 feet), in December; seven specimens received from Mr. G. M. Goldfinch, who has the type.

Euphyia symphona, Meyr.

E. symmolpa, Turn., is a synonym.

Euphyia persimilis, n. sp.

persimilis, very like.

♂, ♀, 35-40 mm. Head ochreous-whitish mixed with fuscous. Palpi in male $1\frac{1}{2}$, in female 2; fuscous; basal joint ochreous-whitish. Antennae grey; in male laminate with short ciliations ($\frac{1}{2}$). Thorax fuscous mixed with whitish. Abdomen grey mixed with whitish; several, obscure, paired, fuscous, dorsal, segmental dots. Legs ochreous-whitish irrorated with fuscous; anterior pair mostly fuscous. Forewings triangular, costa slightly arched, more so at base and towards apex, apex pointed, termen bowed, oblique; whitish; markings and some irroration fuscous, brownish tinged; a moderate basal patch, edged by a convex, transverse, fuscous line; following this a whitish band containing three, suffused, wavy, transverse lines; median band fuscous, moderately broad on costa, constricted from beneath middle to dorsum, containing four, wavy, transverse, dark-fuscous lines, the two central coalescing below middle, and enclosing a paler space, which contains a minute, median, discal dot; antemedian line from $\frac{1}{3}$ costa to mid-

dorsum, dark fuscous, nearly straight, or slightly wavy; postmedian from $\frac{2}{3}$ costa to $\frac{3}{5}$ dorsum, at first wavy and transverse, rather sharply angled outwards in middle, then concave; a double white line succeeds this, then a narrow fuscous line; a fuscous brown terminal band, containing a triangular, whitish, apical spot, from which proceeds a wavy, whitish, subterminal line, preceded by some darker fuscous spots; a dark-fuscous terminal line; cilia fuscous, apices whitish. Hindwings with termen rounded, wavy; pale grey; a grey terminal line; cilia pale grey. Underside grey, with slight fuscous discal dot and postmedian lines on both wings.

Previously confused by me with *E. vacuaria*, Gn., some forms of which it closely resembles. That species has similar antennal structure, but with much longer ciliations ($1\frac{1}{2}$); shorter palpi (male 2, female $2\frac{1}{2}$); antemedian line of forewings twice indented.

New South Wales: Mount Kosciusko (5,000 feet), in January. Victoria: Mount St. Bernard (5,000 feet), in February. Six specimens.

Euphyia cnephaeopa, n. sp.

κνεφαιωπος, dark, gloomy.

♂; ♀, 32-34 mm. Head fuscous. Palpi in male $2\frac{1}{2}$, in female $2\frac{3}{4}$; fuscous, on lower edge towards base mixed with ochreous-whitish. Antennae pale grey; ciliations in male minute. Thorax and abdomen fuscous. Legs dark fuscous, irrorated, and tarsi annulated, with ochreous-whitish. Forewings broadly triangular, costa straight to near apex, apex round-pointed, termen bowed, slightly oblique, wavy; fuscous, with numerous, fine, indistinct, wavy dark-fuscous and pale-fuscous transverse lines; a dark-fuscous discal dot beneath mid-costa; no distinct antemedian line; postmedian sometimes traceable, slightly waved or bisinuate without projection, sometimes marked by minute whitish dots on veins; a very obscure, slender, grey-whitish, crenulate, subterminal line; a dark-fuscous terminal line; cilia fuscous, bases dark fuscous, with a very fine pale median line. Hindwings with termen scarcely rounded, crenulate; as forewings but with lines more distinct, and a rather narrow, darker, median band indicated. Underside similar.

A very obscure species, similar to but larger than *Horisme mortuata*, Gn., and *scotodes*, Turn.; the palpi longer and without sharply defined white basal patch. There are no defined abdominal crests, and only a vestigial thoracic crest as in some other species of *Euphyia*.

New South Wales: Mount Kosciusko (5,000 feet), in December; four specimens received from Mr. G. M. Goldfinch, who has the type.

Dasyuris phaeoxutha, n. sp.

φαιοξουθος, darkly tawny.

♂, ♀, 24-25 mm. Head, thorax, and abdomen dark fuscous with scanty white irroration. Palpi 5; fuscous mixed with whitish hairs, especially beneath. Antennae dark fuscous; ciliations in male minute. Legs fuscous, irrorated, and tarsi annulated, with whitish. Forewings triangular, costa slightly bisinuate, apex subrectangular, termen bowed, slightly oblique, wavy; tawny-fuscous with irroration and markings white and brownish-ochreous; a slender, curved, transverse white line at $\frac{1}{6}$, preceded by a dark line; a more or less double, curved, transverse line at $\frac{1}{3}$, partly white, partly ochreous; a fuscous discal dot in a pale halo beneath midcosta; a double postmedian line at $\frac{2}{3}$, with an angular subcostal and double median projection, not prominent, sometimes dentate, variably white and ochreous; a fine, white, crenulate, subterminal line; cilia fuscous with a few indistinct whitish bars. Hindwings with termen gently rounded, wavy; fuscous-brown, paler towards base; several, fine, transverse, darker lines; cilia as fore-

wings. Underside fuscous-brown with darker transverse lines and discal dots on both wings.

The markings vary in detail.

New South Wales: Mount Kosciusko, in December; eight specimens received from Mr. G. M. Goldfinch, who has the type.

Fam. STERRHIDAE.

Eois perdulcis, n. sp.

perdulcis, very sweet.

♀, 20 mm. Head grey; face and collar fuscous. Palpi pale fuscous. Antennae fuscous, towards base whitish-grey. Thorax and abdomen whitish-grey. Legs whitish, anterior pair fuscous. Forewings triangular, costa straight to near apex, apex round-pointed, termen slightly curved, moderately oblique; grey-whitish; a fine, wavy, outwardly oblique, fuscous-brown line from $\frac{1}{4}$ dorsum reaching half across disc; a fuscous-brown subterminal line, broadly suffused in disc, three times sinuate, with angular slight projections posteriorly; a moderately broad terminal grey suffusion; cilia whitish-grey. Hindwings with termen rounded; grey-whitish; a broadly suffused, median, transverse, fuscous-brown band, with posterior angular projections above and below middle; a broad grey terminal suffusion; cilia grey whitish. Underside whitish-grey.

Exceptionally distinct.

Queensland: Dalby, in January; one specimen.

Eois trissorma, n. sp.

τρισσορμος, with three chains.

♂, 22 mm. Head and collar fuscous; face and palpi dark fuscous. Antennae fuscous; in male dentate, ciliations $1\frac{1}{2}$. Thorax and abdomen brown-whitish. Legs brown-whitish; anterior pair fuscous; posterior tibiae in male without spurs, rather short, smooth, somewhat dilated before apex, tarsi $\frac{2}{3}$. Forewings triangular, costa straight to middle, thence gently arched, apex rounded, termen slightly curved, oblique; brown-whitish; costal edge before middle fuscous; three transverse series of dark-fuscous dots; first at $\frac{1}{4}$, represented by three dots, one subcostal, one on lower edge of cell, and one subdorsal; second median, represented by minute dots on veins; third at $\frac{3}{4}$, dots on veins rather more distinct; a pale subterminal line very faintly indicated towards costa, preceded by slight fuscous suffusion; some dark-fuscous dots on termen; cilia brown-whitish. Hindwings with termen strongly rounded so as to project somewhat in middle, but not angled; as forewings. Underside similar, but markings on forewings and first line on hindwings obsolete.

New South Wales: Ebor Scrub, in January; one specimen.

Somatina eurymitra, n. sp.

εὐρυμιτρος, broadly girdled.

♀, 34 mm. Head fuscous; lower part of face whitish. Palpi ochreous-whitish, upper part of external surface dark fuscous. Antennae grey. Thorax and abdomen whitish-grey. Legs ochreous-grey-whitish; anterior pair fuscous. Forewings broadly triangular, costa straight to $\frac{2}{3}$, thence arched, apex pointed, termen slightly bowed, slightly oblique, wavy; whitish-grey; costal edge ochreous; an ochreous-fuscous subbasal spot; a fine angulated transverse line shortly beyond this, not reaching costa; a very large discal blotch, not reaching costa, ochreous-grey finely irrorated with fuscous, edged anteriorly by a fine fuscous line from beneath $\frac{1}{3}$ costa to mid-dorsum, posteriorly by a line from $\frac{2}{3}$ costa obliquely outwards, angulated posteriorly beneath costa, approaching termen below middle,

then bent inwards to $\frac{5}{6}$ dorsum; an interrupted closely parallel line, thickened and dentate beneath costa and with three large teeth below middle, their apices almost touching termen; a dark-fuscous terminal line; cilia grey. Hindwings with termen rounded, wavy, tornus rather prominent, pointed; as forewings, but without basal markings. Underside grey-whitish.

Queensland: Toowoomba, in September; one specimen received from Mr. W. B. Barnard.

Fam. GEOMETRIDAE.

Pingasa calliglauca, n. sp.

καλλιγλαυκος, beautifully bluish-green.

♂, ♀, 38-44 mm. Head and thorax pale olive-green, irrorated with dark fuscous. Palpi in male $1\frac{1}{2}$, in female $1\frac{3}{4}$; ochreous-whitish, towards apex dark fuscous, with some whitish scales. Antennae dark fuscous; pectinations in male 6, apical $\frac{1}{6}$ simple. Abdomen with lateral scale-tufts; colour as in thorax, occasionally also some brown scales on dorsum towards base; underside whitish. Legs fuscous; tibiae and tarsi annulated with whitish; anterior coxae reddish; posterior pair whitish, or nearly so. Forewings triangular, costa gently arched, apex round-pointed, termen bowed, oblique, crenulate; 11 anastomosing with 12 and 10 (3 males, 6 females), 11 anastomosing with 12, 10 free (1 male), 11 connected with 12 and anastomosing with 10 (2 males, 1 female), 11 connected with 12, 10 free (1 male, 1 female); pale olive-green irrorated with dark fuscous, especially towards base and termen; costa with numerous dark fuscous and sometimes also white strigulae; a dark-fuscous line from $\frac{1}{3}$ costa to $\frac{2}{5}$ dorsum, variable in form, often three times looped or rarely angled posteriorly; a short, outwardly oblique, linear, somewhat blurred, dark-fuscous, median discal mark, rarely edged with brownish; a dark-fuscous line from $\frac{2}{3}$ costa to $\frac{3}{5}$ dorsum, at first outwardly curved, then bent inwards, dentate throughout; an interrupted, wide, dentate, subterminal line edged posteriorly with dark fuscous; a terminal series of dark-fuscous dots; cilia whitish barred with fuscous. Hindwings with termen rounded, dentate; as forewings but without first line; a transverse, antemedian, dark-fuscous shade; rarely some brownish suffusion in basal area. Underside whitish; forewings with an interrupted dark-fuscous costal line, a large round discal spot, a broad terminal band containing a row of white dots, a suffused orange subcostal streak from base rarely absent; hindwings with discal dot and terminal band dark fuscous.

Queensland: Crow's Nest, near Toowoomba, in October, March, and April; Stanthorpe, in November and February. New South Wales: Ebor, in January.

Pingasa viridicata.

Hypochroma viridicata, Luc., Proc. Linn. Soc. N.S. Wales, 1889, p. 1094.

♂, ♀, 48-50 mm. Head green; face with a transverse fuscous line below middle. Palpi 2; green, fuscous, and brown variably mixed; lower surface and base whitish. Antennae grey speckled with dark fuscous; pectinations in male 5, apical $\frac{1}{4}$ simple. Thorax green, mixed anteriorly with brown. Abdomen green more or less mixed with ochreous; beneath pale ochreous. Legs pale ochreous; anterior coxae in male brown; anterior tibiae and tarsi dark fuscous annulated with pale ochreous. Forewings triangular, costa nearly straight, apex round-pointed, termen bowed, oblique; pale green finely dotted with darker green, the veins dotted with white, and sometimes a little white suffusion; costa strigulated with dark fuscous and brown; three, slender, transverse, dark-fuscous and brown transverse lines; first subbasal, incomplete; second from a spot on $\frac{1}{4}$ costa to $\frac{1}{3}$ dorsum, strongly curved outwards beneath costa; third from $\frac{3}{4}$ costa to $\frac{3}{5}$ dorsum, slightly dentate throughout, at first transverse, with two acute projecting teeth in middle, thence inwardly oblique; a median discal spot of raised

brownish and fuscous scales outlined with green; cilia green mixed with whitish and obscurely barred with fuscous-brown. Hindwings with termen rounded, crenulate; as forewings but with postmedian line only. Under surface of both wings whitish-ochreous with fuscous discal spot and suffused reddish subterminal fascia, sometimes mixed with dark fuscous, sometimes preceded on hindwings by a reddish, angulated, postmedian line.

Queensland: Bunya Mountains (3,000 feet), in May; two specimens in good condition received from Mr. W. B. Barnard; previously recorded from Brisbane and Nambour.

Fam. BOARMIADAE.

Hyperythra metabolis.

Callipona metabolis, Turn., Trans. Roy. Soc. S. Austr., 1904, p. 236.

Mr. L. B. Prout informs me that this species is distinct from *rubricata,* Warr.

North Queensland: Townsville.

Hyperythra rubricata.

Hyperythra lutea rubricata, Warr., Nov. Zool., 1898, p. 35.

Hyperythra rubricata, Swin., Trans. Ent. Soc. Lond., 1902, p. 612.

I have not seen this species, but Mr. Prout informs me that it is more nearly allied to the Malayan *H. lutea,* and, like that species, has a hair-pencil on the hindwing, though not so strongly developed.

North Queensland: Claremont Island, Innisfail.

Idiodes ischnora, n. sp.

? *Idiodes primaria,* Meyr., Proc. Linn. Soc. N.S. Wales, 1891, p. 642, *nec* Wlk.

? *Idiodes tenuicorpus,* Prout, Nov. Zool., 1916, p. 49 *(nomen nudum).*

Idiodes ischnora, Turn., Proc. Linn. Soc. N.S. Wales, 1919, p. 219 *(nomen nudum).*

♂, ♀, 34-42 mm. Head, palpi, thorax, and abdomen grey, sometimes more or less reddish; palpi $1\frac{1}{2}$. Antennae whitish on dorsum, grey beneath; ciliations in male minute. Legs grey with some fuscous irroration; posterior tibiae of male dilated. Forewings triangular, costa slightly arched, in female nearly straight, apex pointed, slightly produced, more so in female, termen rather strongly bowed, slightly wavy; 11 arising separately, anastomosing with 12, and then approximated to 10 (2 males), arising separately and anastomosing with 12 and 10 (1 female), connate with 7, 10, anastomosing with 12 and 10 (1 female); grey, with a few fuscous strigulae, sometimes more or less reddish, sometimes purplish; an outwardly curved, somewhat dentate, antemedian fuscous line from $\frac{1}{4}$ costum to $\frac{1}{3}$ dorsum, sometimes faint or obsolete; a median, subcostal, fuscous discal dot; a fuscous line from $\frac{4}{5}$ costa, slightly bent inwards on costa, thence straight to $\frac{2}{3}$ dorsum, with a series of minute whitish dots on veins, or more rarely edged with whitish posteriorly, or double; an extremely slender, dentate, subterminal, pale line sometimes perceptible; costal edge fuscous, interrupted by whitish; cilia concolorous, apices barred with white. Hindwings with termen slightly rounded, wavy; as forewings but without first line, and usually without discal dot, cilia mostly white at apices.

Readily distinguished from *I. apicata* and *I. prionosema* by the partly white cilia of both wings. The thorax and abdomen are also more slender than in *apicata,* but this character if exclusively relied on may lead to error. Walker's type of *I. primaria* is an example of *apicata.* Prout's name and my own were published without description.

North Queensland: Eungella. Queensland: Coolangatta, National Park (2,000 feet), Bunya Mountains (3,000 feet). New South Wales: Bulli. My

Mount Tambourine locality was based on misidentification, but the species will probably be found there.

IDIODES PRIONOSEMA.

? *Idiodes primaria*, Meyr., *nec* Wlk.
? *Idiodes tenuicorpus*, Prout.
Idiodes prionosema, Turn., Proc. Linn. Soc. N.S. Wales, 1919, p. 291.

Recent captures, and especially a series received from Mr. Geo. Lyell, show that this species is more variable than previously suspected. The postmedian line of forewings may be represented only by a series of fuscous, or of whitish dots, or by a continuous whitish line or by a continuous fuscous line edged posteriorly by whitish. The subterminal line may be obsolete, or a fine whitish dentate line, and the fuscous dentations, which precede it in the Ebor specimens, are absent in those from other localities.

New South Wales: Ebor (4,000 feet). Victoria: Monbulk, Lorne. Tasmania: Strahan.

IDIODES FICTILIS.

Idiodes fictilis, Turn., Proc. Linn. Soc. N.S. Wales, 1919, p. 292.
Idiodes argillina, Turn., Trans. Roy. Soc. S. Austr., 1922, p. 289.

A second example (female) taken in the Queensland National Park shows no trace of the large fuscous blotch on forewings of the type of *I. argillina*. Both these examples agree also structurally with *I. fictilis;* in the forewings 10 and 11 arise separately from the cell, 11 anastomosing first with 12 then with 10, 10 anastomosing with 9; the posterior tibiae of the male are not dilated.

Queensland: National Park (2,500-3,500 feet). New South Wales: Gosford.

ANGELIA PLATYDESMA.

Amelora platydesma, Low., Trans. Roy. Soc. S. Austr., 1901, p. 65.
Angelia platydesma, Low., *l.c.*, 1903, p. 194.
Angelia mesophaea, Turn., Proc. Linn. Soc. N.S. Wales, 1919, p. 299.

I think these are identical, though, if so, Lower's description is inexact.

Queensland: Charleville. New South Wales: Bourke, Broken Hill. Victoria: Birchip, Sea Lake.

SMYRIODES CARBURARIA, Gn.

Also from Western Australia: Dowerin (L. J. Newman).

SMYRIODES GALEARIA, Gn.

Nearly allied to the preceding. My genus *Symmiges* should be dropped.

FISERA HALURGA, Turn.

Queensland: Gayndah, Toowoomba, Charleville. Four examples from the last locality, including both sexes, have the hindwings rather paler than the type.

Smyriodes adelosticha, n. sp.

ἀδηλοστιχος, with inconspicuous lines.

♂, 34 mm. Head pale grey. Palpi 1; pale grey. Antennae pale grey; in male with short pectinations (1) to apex, each pectination with short apical cilia. Thorax and abdomen pale grey with scanty dark-fuscous irroration. Legs whitish irrorated with fuscous; anterior pair mostly dark fuscous. Forewings triangular, costa uniformly and rather strongly arched, apex pointed, termen bowed, oblique; pale grey; markings fuscous; a fine line from $\frac{1}{3}$ costa, very acutely angled outwards beneath costa, then strongly oblique inwardly to dorsum near base; a very fine sinuate line from $\frac{2}{3}$ costa to $\frac{2}{3}$ dorsum, acutely dentate on veins; a suffused, inwardly-oblique streak from apex to second line; a terminal

series of small blackish dots; cilia pale grey. Hindwings with termen strongly rounded; whitish, with some fuscous irroration towards termen. Underside whitish; both wings with fuscous discal dot, and postmedian line of fuscous dots.

Dissimilar to previously described species, but structurally a true *Smyriodes*.

Western Australia: Merredin; one specimen received from Mr. L. J. Newman.

Capusa chionopleura, n. sp.

χιονοπλευρος, with white costa.

♀, 42 mm. Head fuscous, with some whitish points; face with a strong rounded prominence. Palpi $2\frac{1}{2}$; fuscous. Antennae white; towards apex fuscous. Thorax fuscous. Abdomen grey-whitish; beneath fuscous. Legs fuscous; anterior tibiae with a strong apical hook. Forewings rather narrowly triangular, costa very slightly and uniformly arched, apex pointed, termen bowed, oblique, crenulate; 10 and 11 arising separately from cell, not anastomosing; dark fuscous; a broad, white, costal streak from base to apex; cilia dark fuscous. Hindwings with termen rounded; white; cilia white, on apical half of termen barred with fuscous. Underside whitish, with suffused, fuscous, apical blotches on both wings.

Queensland: Charleville, in September; one specimen.

Gen. CIAMPA, Wlk.

This name must be adopted instead of *Ceratucha,* Turn.

Ciampa glaridocrana, n. sp.

γλαριδοκρανος, chisel-headed.

♂, 32 mm. Head grey; face with a short chitinous conical projection, its apex chisel-shaped and horizontal. Palpi short (under 1); grey. Antennae whitish-grey; pectinations in male 5. Thorax grey. Abdomen and legs whitish-grey. Forewings narrow, oval, costa moderately arched, apex rounded, termen very obliquely rounded; grey with patchy fuscous irroration; costa more densely irrorated; an outwardly-oblique short fuscous line from $\frac{1}{3}$ costa, with fuscous dots on veins between its apex and $\frac{1}{3}$ dorsum; a fuscous discal dot at $\frac{2}{3}$; postmedian line obsolete, indicated by some dots on veins; cilia grey. Hindwings broad, termen slight rounded, wavy; grey-whitish.

The palpi and frontal process are much shorter than in *C. arietaria.* It is nearer *C. heteromorpha,* but in this the apex of the frontal process is flattened laterally, not vertically.

Western Australia: Perth; one specimen received from Mr. L. J. Newman.

Chlenias leptoneura, n. sp.

λεπτονευρος, with slender nerves.

♀, 39 mm. Head fuscous; face with strong rounded prominence. Palpi $1\frac{1}{4}$; whitish with some fuscous scales. Antennae grey. Thorax grey; a broad, longitudinal, dark-fuscous bar between crests. Abdomen grey. Legs whitish; anterior pair and all tarsi grey. Forewings elongate-triangular, costa nearly straight, but slightly arched towards apex, apex pointed, termen slightly bowed, moderately oblique; 10 free; grey; veins very slenderly outlined with fuscous; a suffused fuscous spot on dorsum slightly beyond middle; cilia grey. Hindwings with termen scarcely rounded; pale grey; towards base whitish; cilia grey-whitish. Underside grey.

Western Australia: Perth; one specimen received from Mr. L. J. Newman.

Gen. **Omoplatica**, nov.

ὠμοπλατικος, with shoulder-blades.

Face not projecting, rough-haired. Tongue strongly developed. Palpi moderate, porrect; basal and second joints clothed with long rough hairs; terminal joint long, smooth, obtuse. Antennae in male bipectinate to apex. Thorax not crested; shoulder-flaps with very long hairs reaching nearly to middle of abdomen; densely hairy beneath. Abdomen without crests. Femora densely hairy. Posterior tibiae in male not dilated. Forewings in male without fovea; 10 and 11 arising separately from cell, 10 connected with 9, 11 free. Hindwings normal; cell $\frac{1}{2}$; 8 approximated to cell to beyond middle.

In four examples the neuration is constant. The genus differs from *Chlenias* and *Stibaroma* in the absence of any thoracic crest, the very long shoulder-flaps (which may be confined to the male sex), and the shorter cell of the hindwings.

Omoplatica holopolia, n. sp.

ὁλοπολιος, wholly grey.

♂, 45-46 mm. Head brownish; face pale grey. Palpi $2\frac{1}{4}$; fuscous, inner surface whitish; terminal joint $\frac{3}{4}$. Antennae whitish-grey; pectinations in male 6. Thorax grey, anteriorly brownish-tinged. Abdomen pale grey; tuft and underside whitish. Coxae and femora whitish; tibiae and tarsi fuscous, the latter with whitish annulations. Forewings elongate-triangular, costa nearly straight, apex acute, termen bowed, strongly oblique, slightly crenulate; pale grey; some fuscous irroration on veins; a fine, fuscous, interrupted, terminal line; cilia grey-whitish. Hindwings with termen rounded, slightly crenulate; grey; towards base whitish; a postmedian, curved, transverse line of minute fuscous dots; a fine, interrupted, fuscous, terminal line; cilia whitish. Underside whitish; forewings with a subterminal line of minute fuscous dots, and sometimes a discal dot; hindwings with distinct discal dot, a postmedian line of dots, and a median terminal blotch, fuscous.

Western Australia: Merredin; four specimens received from Mr. L. J. Newman.

Gen. Paralaea, Meyr.

Proc. Linn. Soc. N.S. Wales, 1891, p. 670.

Paralaea promacha, Meyr.

Proc. Linn. Soc. N.S. Wales, 1891, p. 671.

This genus and species, which I have not seen, were accidentally omitted from my revision of the family.

Western Australia: Albany.

Fam. EPIPLEMIDAE.

Balantiucha cyclocrossa, n. sp.

κυκλοκροσσος, with rounded margin.

♂, 21-26 mm. Head with crown fuscous, fillet white, face dark fuscous. Palpi dark fuscous. Antennae white; in male with close-set whitish-ochreous laminae. Thorax and abdomen grey. Legs whitish; anterior pair fuscous. Forewings triangular, costa gently arched, apex rounded, termen rounded, oblique, dorsum strongly concave; grey finely strigulated with fuscous; absence of strigulation sometimes causes an indistinct pale transverse fascia from $\frac{3}{4}$ costa to termen above tornus; sometimes a similar terminal line; a submarginal series

of black dots between veins, sometimes obsolete towards tornus; a small semicircular dorsal blotch beyond middle, fuscous, in centre grey; cilia grey. Hindwings with termen strongly and evenly rounded; as forewings, but without dorsal blotch; a fine curved fuscous transverse median line. Underside grey.

Allied to *B. leucocera*, Hmps., and *B. leucocephala*, Wlk., but differs from both in the absence of a defined postmedian line in forewings. The male of *leucocera* in addition to its brown colouring may be distinguished by the strong triangular tuft on costa of hindwings. In the male of *leucocephala* the termen of hindwings is distinctly angled above middle.

Queensland: Bunya Mountains, in January; four specimens.

Fam. SCHOENOBIADAE.

The following is a key to the Australian genera of this small family:—

1.	Palpi short, not projecting beyond frons	NIPHOPYRALIS
	Palpi porrect, projecting beyond frons	2
2.	Forewings with 2 and 3 stalked	POGONOPTERA
	Forewings with 2 and 3 separate	3
3.	Forewings with 7, 8, 9 stalked	RAMILA
	Forewings with 7 not stalked with 8, 9	4
4.	Hindwings with 7 and 12 anastomosing for some distance	5
	Hindwings with 7 and 12 not anastomosing, or at a point only	STYPHLOLEPIS
5.	Forewings with 6 and 7 stalked	THYRIDOPHORA
	Forewings with 6 and 7 separate	6
6.	Forewings with 8, 9, 10 stalked	BRIHASPA
	Forewings with 10 separate	7
7.	Posterior tibiae smooth	8
	Posterior tibiae rough-scaled	CIRRHOCHRISTA
8.	Palpi moderate, not exceeding 2, terminal joint short; shoulder-flaps in male with rough, spreading hairs	SCIRPOPHAGA
	Palpi long, usually over 3, terminal joint long; shoulder-flaps in male without rough, spreading hairs	SCHOENOBIUS

Gen. BRIHASPA, Moore.

Proc. Zool. Soc., 1867, p. 666; Hmps., Proc. Zool. Soc., 1895, p. 909.

To this genus I refer *stenopteralis*, Hmps. (Ann. Mag. Nat. Hist. (9), iv., p. 316, 1919); *atricostalis*, Hmps. *(loc. cit.*, p. 317); *tinctalis*, Hmps. *(loc. cit.*, p. 315); and *pentamita*, Turn. (Ann. Q'land Mus., x., p. 119, 1911). I think *Brihaspa, Patissa*, Moore, and *Donacaula*, Meyr., are probably congeneric.

Gen. THYRIDOPHORA, Warr.

Proc. Zool. Soc., 1888, p. 311; Hmps., *l.c.*, 1895, p. 905.

Labial palpi porrect, long or very long; terminal joint long, bent slightly downwards. Maxillary palpi strongly dilated at apex. Forewings with cell $\frac{2}{3}$ to $\frac{3}{4}$, 6 and 7 stalked from upper angle of cell, 10 and 11 arising separately from cell. Hindwings with 4 and 5 approximated at origin, 7 anastomosing with 12. Type *T. furia*, Swin., from India. This has a vesicular gland on underside of forewings, which is absent in the Australian species.

Thyridophora gilva, n. sp.

gilvus, pale yellow.

♂, ♀, 30-32 mm. Head whitish. Palpi 5; pale ochreous; inner surface and lower edge whitish. Antennae whitish; in male shortly bipectinate (1), extreme apex simple. Thorax pale ochreous with a few fuscous scales. Abdomen and legs whitish. Forewings elongate, posteriorly dilated, costa sinuate, apex rectangular, termen and dorsum continuously rounded; pale ochreous becoming whitish towards termen, sparsely irrorated with large fuscous scales; an indistinct fuscous ring beneath midcosta; a curved, whitish, subterminal line, free

from irroration, from costa before apex to dorsum at $\frac{1}{3}$, edged anteriorly with fuscous; sometimes a fine fuscous line in disc before and parallel to this; cilia whitish with a fuscous-grey basal line. Hindwings $1\frac{1}{2}$, termen rounded; whitish with slight fuscous irroration towards termen; cilia as forewings.

Queensland: Clermont, in September; four specimens received from Mr. E. J. Dumigan.

Fam. PYRAUSTIDAE.

Nacoleia chlorura.

Ceratoclasis chlorura, Meyr., Trans. Ent. Soc. Lond., 1887, p. 222.
Nacoleia melanauges, Turn., Proc. Roy. Soc. Q'land, 1912, p. 145.

Anterior tarsi and lower half of tibiae thickened with a double row of dense curved scales on dorsum in male.

North Queensland: Cooktown, Cairns.

Nacoleia leucophrys, n. sp.

λευκοφρυς, with white eyebrows.

♂, 20 mm. Head fuscous; side-tufts whitish. Palpi fuscous; base beneath obliquely white, sharply defined. Antennae fuscous; in male with dorsal groove at $\frac{2}{5}$, preceded by a tuft, ciliations 1. Thorax fuscous. Abdomen fuscous; dorsum of second segment and underside whitish. Legs fuscous; tarsi with whitish annulations. Forewings white without ochreous tinge; markings dark fuscous, somewhat suffused; a moderate basal patch; a transverse line at $\frac{1}{6}$; a moderate transverse fascia at $\frac{1}{4}$; four small rings on costa at $\frac{1}{3}$, $\frac{1}{2}$, $\frac{2}{3}$, $\frac{5}{6}$; a median transverse fascia broadly interrupted in middle, or obsolete also towards dorsum; a finely dentate subterminal line, followed by a slender white line; a terminal band containing an irregular white spot above tornus close to termen; cilia fuscous, bases and several suffused bars whitish. Hindwings with termen sinuate; as forewings but basal patch very small, without subbasal line, median fascia, subterminal line, and costal rings. Underside similar.

Queensland: Yeppoon, in October; one specimen.

Fam. CARPOSINIDAE.

Carposina chaetolopha, n. sp.

χαιτολοφος, with mane-like crest.

♂, ♀, 25-28 mm. Head whitish; crown fuscous tinged. Palpi 5; fuscous; upper edge whitish. Antennae fuscous; ciliations in male 1. Thorax fuscous or fuscous-whitish. Abdomen grey; base of dorsum sometimes whitish. Legs fuscous; tarsi with whitish annulations. Forewings narrow, posteriorly dilated, costa moderately arched, apex pointed, termen nearly straight, in male strongly, in female moderately, oblique; fuscous with a small but variable amount of whitish and ferruginous irroration; dark-fuscous dots of raised scales, first close to base, second subbasal beneath fold, third on costa at $\frac{1}{5}$, fourth beneath fold at $\frac{1}{3}$, edged with whitish, fifth above fold slightly posterior to fourth, sixth and seventh placed transversely in middle, not all equally distinct; an obscure dentate line from $\frac{2}{3}$ costa to $\frac{3}{4}$ dorsum succeeded by a paler or whitish area; an indistinct transverse subterminal dark shade; veins in apical area more or less outlined with darker scales; cilia fuscous. Hindwings with termen slightly sinuate; cubital pecten in male consisting of very long dense fuscous hairs extending beyond $\frac{1}{3}$, in female normal; pale grey; cilia pale grey.

Western Australia: Mundaring, in June; two specimens. A paler somewhat worn female, from Perth, appears to be the same species.

Carposina petraea, Meyr.

C. eulopha, Turn., is a synonym.

Fam. TORTRICIDAE.

Isochorista melanocrypta, Meyr.

In male with a small hair-pencil from side of thorax directed backwards from beneath origin of forewing. This and the dark suffusion of underside of wings are absent in the female.

Gen. **Anisochorista**, nov.

ἀνισοχωριςτος, unequally separated.

Palpi moderate, porrect; second joint dilated with rough scales above and beneath; terminal joint short. Thorax with a strong posterior crest. Forewings with 3 from angle, 7 and 8 stalked, 7 to termen. Hindwings with 2 widely remote from 3, 3 and 4 separate but somewhat approximated at origin, 5 widely separate from 4 at origin, 6 and 7 stalked.

Distinguished from *Isochorista* by 4 being much nearer 3 than 5 at origin, and by the strong thoracic crest. The type *A. callizyga*, Low., has at present no known near ally.

Anisochorista callizyga, Low.

New South Wales: Katoomba, Mount Wilson. Victoria: Gisborne. South Australia: Mount Lofty, Mount Gambier.

Acropolitis stenoptycha, n. sp.

στενοπτυχος, with narrow fold.

♂, 20 mm. Head dark fuscous; lower edge of face white. Palpi $1\frac{1}{2}$; fuscous; apex and inner surface white. Antennae white with blackish annulations; ciliations in male 1. Thorax dark fuscous irrorated with white. Abdomen grey. Legs whitish; tibiae and tarsi fuscous with whitish annulations, except posterior pair. Forewings suboblong, costa moderately arched, apex rounded-rectangular, termen obliquely rounded; costal fold in male very short and narrow, extending to $\frac{1}{5}$; whitish with uneven fuscous irroration and strigulation; markings dark fuscous; basal patch very ill-defined; central fascia represented by an irregular angulated blotch in middle of disc, connected by irregular suffusion with costa and dorsum; a suffused costal triangle with darker strigulae; a curved triangular blotch above tornus, its apex downwards; a spot on termen beneath apex; cilia whitish with basal and apical fuscous lines. Hindwings with termen sinuate; pale grey; cilia pale grey.

Characterised by its small size, rudimentary costal fold, and the absence of any ochreous or ferruginous colouring.

Queensland: Brisbane, in September; one specimen.

Lamyrodes molybdospora, n. sp.

μολυβδοσπορος, leaden-spotted.

♂, ♀, 15-17 mm. Head and thorax pale ochreous irrorated with ferruginous. Palpi $1\frac{1}{2}$; pale ochreous; terminal joint fuscous. Antennae blackish annulated with white; ciliations in male $1\frac{1}{2}$. Abdomen fuscous; tuft and under side ochreous-whitish. Legs fuscous; anterior and middle tibiae annulated with ochreous-whitish; posterior pair almost wholly ochreous-whitish. Forewings rather narrow, costa gently arched, apex rounded, termen very obliquely rounded; in male without costal fold; pale ochreous irrorated with ferruginous; numerous leaden metallic dots; the ferruginous scales sometimes form an oblique

fascia from before middle of costa to tornus, and a costal blotch before apex; some dark-fuscous costal dots; cilia pale ochreous. Hindwings with termen sinuate; dark grey; cilia grey.

South Australia: Glenelg, near Adelaide, in April; two specimens received from Mr. J. D. O. Wilson.

Lamyrodes stenozona, n. sp.

στενοζωνος, narrowly banded.

♀, 18 mm. Head and thorax fuscous mixed with pale ochreous. Palpi 2; pale ochreous. Antennae fuscous. Abdomen fuscous; beneath pale ochreous. Legs pale ochreous; in anterior and middle pairs mixed with fuscous. Forewings rather narrow, not dilated, costa slightly arched, apex pointed, termen slightly bowed, very oblique; pale ochreous with a few grey and fuscous scales; markings fuscous-brown mixed with grey; basal patch mostly obsolete, represented by irregular dots on costa and fold and by a few scattered dark scales; a broad dorsal streak from $\frac{1}{4}$ to middle; a narrow fascia from midcosta to tornus, its edges irregularly dentate; an elongate apical patch containing two pale-ochreous costal dots; cilia pale ochreous, towards tornus grey. Hindwings with termen sinuate; fuscous; cilia pale fuscous with a darker basal line.

Victoria: Daytrap, in October; two specimens. Judging from these, the species is variable. Type in Coll. Lyell.

Capua castanitis, Turn.

I have now a long series from the Queensland National Park in October and November, ranging from a low level to 3,500 feet. My description applies well to the female, but the male, which has antennal ciliations $\frac{2}{3}$ and costal fold absent, shows more distinct markings. The basal patch is usually narrowly edged with dark fuscous, the central fascia and costal triangle dark fuscous, the former rather narrow, often constricted or divided into two or three spots.

Capua hedyma, Turn.

I took one of each sex in the Queensland National Park, at 4,000 feet, in November. The female expands 25 mm. and has the forewings almost uniformly reddish-ochreous, the markings of the male being only faintly indicated.

Capua microphaea, n. sp.

μικροφαιος, small dusky.

♂, 14 mm. Head pale brown. Palpi 3; pale brown. Antennae pale brown finely annulated with dark fuscous; ciliations in male $1\frac{1}{2}$. Thorax, abdomen, and legs fuscous. Forewings suboblong, costa slightly arched, apex obtusely pointed, termen straight, oblique; in male without costal fold; brown-whitish suffused with grey; markings fuscous-brown; a rather large basal patch followed by a pale area; central fascia with anterior edge transverse, angulated outwards in disc and inwards above dorsum, from $\frac{2}{5}$ costa to beyond middle of dorsum, posterior edge undefined, merging in a dark-grey suffusion, which extends to termen; some dark-fuscous costal dots, with a larger spot at $\frac{4}{5}$; cilia grey, apices ochreous-whitish. Hindwings with termen scarcely sinuate; 3 and 4 connate; grey; cilia grey.

Not unlike *C. isographa,* Meyr., but readily distinguished by the longer antennal ciliations.

Queensland: National Park (3,000 feet), in November; one specimen.

Capua dyslecta, n. sp.

δυσλεκτος, hard to distinguish.

♀, 18 mm. Head and thorax whitish-ochreous. Palpi $2\frac{1}{2}$; whitish-ochreous with some fuscous irroration. Antennae whitish-ochreous with dark-fuscous dots on dorsal surface. Abdomen grey; tuft very large, its apex fuscous. Legs whitish-ochreous with some fuscous irroration. Forewings subtriangular, costa moderately arched, apex round-pointed, termen slightly rounded, oblique; very pale ochreous with a few dark-fuscous scales, which form transverse strigulae towards base, and again before termen; three, moderate, whitish, transverse fasciae partly edged with dark-fuscous scales; first from $\frac{2}{5}$ dorsum not reaching costa; second from $\frac{2}{5}$ costa to $\frac{4}{5}$ dorsum; third from $\frac{4}{5}$ costa to tornus; cilia pale ochreous with a few fuscous points at apices. Hindwings with termen scarcely sinuate; 3 and 4 connate; whitish; cilia whitish.

The distinctness of this species is not at first obvious, for the pale fasciae are almost invisible except under oblique illumination.

Queensland: National Park (2,500 feet), in November; one specimen taken in open forest country.

Capua catharia, n. sp.

καθαριος, neat.

♀, 16-17 mm. Head, thorax, and antennae fuscous. Palpi $2\frac{1}{2}$; fuscous, upper edge whitish. Abdomen and legs fuscous. Forewings moderate, not dilated, costa moderately arched, apex rounded, termen slightly rounded, slightly oblique; grey-whitish; markings fuscous; a moderate basal patch, angulated outwards in middle, containing two obscure darker transverse lines; a series of dorsal dots; a dot on $\frac{1}{5}$ costa shortly beyond basal patch, giving origin to a very slender indistinct line to second dorsal dot; median fascia from costa before middle, anterior edge straight, rather narrow on costa, broadening greatly in disc, so that posterior edge reaches tornus; a well-developed triangular subapical costal patch; a supratornal spot; an obscure terminal line; cilia grey-whitish with basal and subapical fuscous lines. Hindwings with termen scarcely sinuate; 3 and 4 connate; whitish with numerous grey transverse strigulae; cilia whitish with basal and subapical grey lines.

Victoria: Daytrap, in September; two specimens. Type in Coll. Lyell.

Homona hilaomorpha, n. sp.

ἱλαομορφος, of cheerful appearance.

♂, 20-22 mm. Head and thorax fuscous. Palpi short (about 1), smooth scaled, obliquely ascending; fuscous. Antennae fuscous; ciliations very short ($\frac{1}{5}$). Abdomen grey; base of dorsum brown; underside ochreous. Legs fuscous; tarsi annulated with whitish-ochreous; posterior pair, except tarsi, whitish-ochreous. Forewings broad, suboblong, costa with a rounded angle at $\frac{2}{5}$, thence sinuate, apex rectangular, termen straight, not oblique, rounded beneath; 7 and 8 connate; whitish-ochreous strigulated and suffused with grey; costal fold short, reaching to $\frac{1}{4}$, very broad, and approximately semicircular, fuscous; a small fuscous basal patch between fold and dorsum; beyond this a broad brownish-grey suffusion limited by a line from $\frac{1}{4}$ costa to tornus, angled in middle of disc; a moderate fuscous-brown costal triangle, succeeded by a costal dot; a double series of dark-fuscous strigulae before termen; cilia brown with a fuscous line beyond middle. Hindwings with termen slightly sinuate; pale ochreous with some fuscous strigulae, towards base and dorsum fuscous-grey; cilia fuscous, on middle of termen pale ochreous.

♀, 22-24 mm. Head and thorax brown. Forewings with termen strongly sinuate, apex acute, produced, termen sinuate; purple-grey finely strigulated with

fuscous and brown; a fuscous subcostal dot representing costal triangle. Hindwings deeper ochreous.

So far as recorded all other species of *Homona* have 7 and 8 of forewings stalked. The definition of the genus must be slightly broadened to include this species, which certainly must be referred here.

Queensland: National Park (2,500-3,000 feet), in November; five specimens.

Tortrix eurystropha, n. sp.

εὐρυστροφος, broad-banded.

♂, 22 mm. Head brown. Palpi $2\frac{1}{2}$; brown. Antennae grey; ciliations in male $1\frac{1}{4}$. Thorax fuscous-brown, paler posteriorly. Abdomen grey. Legs fuscous-brown; tarsi angulated with ochreous-whitish; posterior pair ochreous-whitish. Forewings suboblong, costa arched to middle, thence straight, apex rectangular, termen straight, rounded beneath, scarcely oblique; costal fold in male narrow and rudimentary, but with a small triangular tuft of scales before its apex, which reaches to middle; whitish-grey with brownish suffusion and some dark-fuscous irroration; markings fuscous-brown; a moderate ill-defined basal patch; central fascia and costal triangle completely fused, extending on costa from $\frac{1}{4}$ nearly to apex, narrowing rapidly in disc, but still moderately broad at tornus, anterior edge oblique, more strongly so below middle, posterior edge excavated in middle, with a rectangular bend above tornus; a small ill-defined median terminal blotch; cilia brown with a blackish subbasal line, apices whitish. Hindwings with termen sinuate; whitish coarsely strigulated with grey; cilia whitish, with a grey subbasal line.

Queensland: National Park (2,500 to 3,000 feet), in October and November; two specimens.

Tortrix lythrodana, Meyr.

Cnephasia trissochorda, Turn., is a synonym.

Queensland: Stanthorpe. New South Wales: Katoomba, Mount Kosciusko (5,000 feet). Victoria: Melbourne, Wandin, Lorne, Gisborne, Mount St. Bernard (5,000 feet). Tasmania: Mount Wellington, Lake Fenton (3,500 feet), Cradle Mountain (3,000 feet), Burnie, Strahan. South Australia: Mount Lofty.

Tortrix notophaea, n. sp.

νωτοφαιος, dusky-backed.

♂, 20 mm. Head and thorax brownish-fuscous. Palpi 3; brownish-fuscous. Antennae ochreous-whitish; ciliations in male $\frac{1}{2}$. Abdomen grey. Legs fuscous; tarsi with whitish annulations. Forewings strongly dilated posteriorly, costa straight near base, thence moderately arched, apex rounded-rectangular, termen slightly oblique, rounded beneath; costal fold narrow, reaching $\frac{2}{5}$; pale brownish-ochreous; dorsal area pale fuscous throughout to about $\frac{1}{3}$ breadth of wing before middle, there suddenly broadening to $\frac{1}{2}$, with sharply defined edge, which before termen is deflected upwards to just beneath apex; basal patch obsolete, but its posterior edge indicated by an indistinct pale-fuscous line indented below middle; several fuscous costal dots beyond middle, a median fuscous spot at $\frac{2}{3}$ confluent with dorsal fuscous area; between this and tornus several blackish dots; cilia pale brownish-ochreous. Hindwings with termen scarcely sinuate; pale grey; cilia pale grey.

New South Wales: Sydney. One specimen emerged at the Cawthron Institute, New Zealand, from twigs of *Acacia decurrens,* collected at Epping, Sydney, and was received by me from Mr. A. J. Philpott.

Arotrophora siniocosma, n. sp.

σινιοκοσμος, with sieve-like ornament.

♀, 28 mm. Head white, ochreous tinged. Palpi 7; brownish-ochreous; lower edge and internal surface, except of terminal joint, white. Antennae ochreous, paler towards base. Thorax whitish; anterior and posterior edge partly orange. Abdomen and legs whitish. Forewings strongly dilated posteriorly, costa gently arched near base, thence nearly straight, apex rounded-rectangular, termen nearly straight, not oblique; whitish-grey with numerous, transverse, brownish-orange strigulae, partly connected to form a fine network; a white costal streak, edged towards disc with ochreous, from base nearly to apex; cilia orange. Hindwings broad; white with fine, grey-whitish, transverse strigulae; cilia white.

One of the *A. ochraceella* group.

Queensland: Yeppoon, in October; one specimen.

SCHOENOTENES LEUCOPTERA, Turn.

Having obtained further material, taken in the Queensland National Park at 2,500-3,000 feet in November, also from Bunya Mountains at 3,000 feet in January, I find that my *Tortrix leucoptera* must be referred to this genus. The forewings show tufts of raised scales, the cell is narrow posteriorly and contains a strong chorda, in the hindwings the cell is short ($\frac{1}{3}$), 6 and 7 are connate, gradually diverging from base. The male shows no costal fold, and the antennal ciliations are 1.

SCYPHOCEROS THOLERA, Turn.

To the description of this species should be added:—Face with a deep hollow above between bases of antennae; white.

Gen. DICELLITIS, Meyr.

Of the three Australian species I refer to this genus, *D. zostrophora* has 3 and 4 of forewings stalked; in *D. theticophora* and in the species described below these veins are approximated at origin.

Dicellitis cavifrons, n. sp.

cavifrons, hollow-faced.

♂, 15-16 mm. Head fuscous; face smooth, concave, white. Palpi 2, curved upwards; brown-whitish becoming fuscous towards apex. Antennae ochreous-whitish finely barred with dark fuscous on dorsal surface; in male with short pectinations (1) to apex and shorter ciliations. Thorax fuscous. Abdomen grey. Legs fuscous; tarsi annulated with whitish-ochreous; posterior pair whitish-ochreous. Forewings narrow, subovate, costa moderately arched, apex rounded, termen obliquely rounded; costal fold in male well developed, extending to $\frac{2}{5}$; several tufts of raised scales in disc; ochreous-whitish suffused with fuscous-brown, markings fuscous-brown, very indefinite; a suffused basal patch, produced on costa, its outer margin not angled; a large undefined suffusion in disc representing central fascia; a small costal triangle; cilia pale fuscous, bases whitish. Hindwings broad, termen not sinuate; fuscous, paler near apex and termen; cilia as forewings.

Very obscure, but very distinct by its structural characters.

Queensland: National Park (3,500 feet), in December and January; two specimens.

Gen. **Trychnophylla**, nov.

τρυχνοφυλλος, rough-winged.

Palpi $1\frac{1}{4}$, ascending; second joint smooth above, beneath with a large apical tuft; terminal joint rather long (about $\frac{1}{2}$ second). Thorax with a small posterior crest (?). Forewings with small tufts of raised scales; 7 and 8 stalked, 7 to apex. Hindwings with 3 and 4 connate or short-stalked, 5 moderately approximated at origin, 6 and 7 stalked.

Trychnophylla taractica, n. sp.

ταρακτικος, turbulent.

♀, 16 mm. Head and thorax fuscous-whitish. Palpi fuscous; extreme apex and inner surface ochreous-whitish. Antennae whitish annulated with blackish. Abdomen fuscous. Legs ochreous-whitish; tibiae and tarsi, except posterior pair, fuscous annulated with ochreous-whitish. Forewings suboblong, rather narrow, costa slightly arched, apex rounded, termen obliquely rounded; grey mixed with whitish, finely strigulated and irrorated with dark fuscous; many dark-fuscous costal dots, some of which give rise to broken transverse lines or series of strigulae; an interrupted terminal line; cilia grey, bases with obscure paler bars. Hindwings with termen slightly sinuate; grey; cilia grey.

Queensland: Toowoomba, in October; one specimen.

Gen. **Apateta**, nov.

ἀπατητος, novel.

Head rough-scaled. Tongue well developed. Palpi extremely long, porrect; second joint extremely long, with long rough scales above and beneath; terminal joint long, smooth, apex obtusely rounded. Forewings smooth; 2 from before $\frac{2}{3}$, 3 from angle, 7 and 8 stalked, 7 to apex; a forked median vein weakly developed in distal half of cell. Hindwings without cubital pecten; cell over $\frac{2}{3}$, 2 from $\frac{2}{3}$, 3 and 4 connate, 4, 5, 6, 7 equidistant, parallel; a weakly developed forked median vein in cell.

An isolated and primitive genus. The neuration of the hindwings is of the primitive type that has been preserved in the Oecophoridae; among the Tortricidae it is only known as *Isotrias*.

Apateta cryphia, n. sp.

κρυφιος, hidden.

♀, 27 mm. Head and thorax fuscous. Palpi grey with some whitish irroration, extreme base white. Abdomen ochreous-whitish with a broad fuscous bar across dorsum of each segment; beneath fuscous with slight whitish irroration. Legs fuscous; posterior pair whitish-grey. Forewings elongate, not dilated, costa moderately arched throughout, apex round-pointed, termen oblique, slightly rounded; fuscous with a very few white scales mostly between spots and near fold; two small white discal spots, first slightly beyond $\frac{1}{3}$, second at $\frac{2}{3}$; cilia fuscous with a few white scales. Hindwings with termen rounded; pale grey; cilia pale grey.

This singular species at first sight suggests a *Carposina*.

Western Australia: Waroona, in October; one specimen received from Mr. R. Illidge.

Gen. Phricanthes, Meyr.

Proc. Linn. Soc. N.S. Wales, 1881, p. 636.

Type *P. asperana*, Meyr. This name must be adopted for the genus I defined under the name *Colocyttara*.

Gen. Palaeotoma, Meyr.

In this genus 7 and 8 of forewings are closely approximated at origin and for some distance. My genus *Trachyptila* was founded on a misapprehension. In the type of *T. melanosticha* 7 and 8 are actually stalked, but this is merely a structural aberration, though one that is very unusual, if not unique in this family. In *T. phaulodes* these veins, though not stalked, actually touch each other for some distance. Both these names are synonyms of *P. styphelana*, Meyr.

Fam. EUCOSMIDAE.

Spilonota honesta, Meyr.

Eucosma leuconephela, Turn., is a synonym.

New South Wales: Glen Innes, Barrington Tops. Victoria: Melbourne, Geelong, Gisborne. Tasmania: Hobart, Deloraine, Cradle Mountain (3,000 feet), Zeehan.

Acroclita ochropepla, n sp.

ὠχροπεπλος, in pale clothing.

♂, 12 mm. Head, thorax, and abdomen pale fuscous. Palpi 2; white; second joint with incomplete, pale fuscous, subbasal, and median, transverse bars. Antennae fuscous, in male thickened, ciliations imperceptible. Legs whitish; tarsi annulated with fuscous. Forewings with costa gently arched, apex subrectangular, slightly produced, termen not oblique; without costal fold; whitish; numerous, fuscous, short costal streaks; a large, quadrangular, very pale-fuscous dorsal blotch from base, extending half across disc; central fascia very pale fuscous, from midcosta, where it is very narrow, expanded from mid-disc to dorsum; where it is partly confluent with basal blotch, and extends to $\frac{3}{4}$; two longer oblique costal streaks before apex, and an apical spot, fuscous; ocellus represented by a quadrangular whitish area, margined with fuscous, and containing one or two, fine, short, longitudinal, fuscous lines; cilia whitish, partly fuscous around apex. Hindwings with termen sinuate; 3 and 4 stalked; grey; cilia grey.

Queensland: Byfield, near Yeppoon, in October; one specimen.

Eucosma polyphaea, n. sp.

πολυφαιος, very dark.

♂, 12 mm. Head, thorax, and abdomen fuscous. Palpi 2; second joint subascending, shortly rough-scaled; fuscous. Antennae fuscous; ciliations in male $\frac{1}{2}$. Legs fuscous; tarsi with obscure whitish annulations; posterior pair except tarsi whitish. Forewings narrow-oblong, not dilated, costa nearly straight, apex subrectangular, termen sinuate; in male with a strong costal fold extending to $\frac{1}{3}$; fuscous; costa with very fine, obscure, oblique, whitish strigulae arranged in pairs; ocellus represented by a large quadrangular leaden-metallic blotch containing some fuscous irroration; cilia fuscous, apices of scales whitish, on tornus mostly whitish. Hindwings broader than forewings, termen scarcely sinuate; pale grey; cilia pale grey.

Queensland: Yeppoon, in October; one specimen.

Eucosma leucatma, n. sp.

λευκατμος, smoky-white.

♂, 14 mm. Head, thorax, and abdomen dark fuscous. Palpi $1\frac{1}{2}$; dark fuscous. Antennae fuscous; in male thickened, ciliations extremely minute, in fascicles. Legs fuscous; in male middle tibiae expanded by rough hairs, posterior tibiae and tarsi abbreviated, the latter with long hairs on dorsum, middle and

posterior tarsi with apical joints whitish. Forewings moderately broad, strongly dilated posteriorly, costa gently arched, apex subrectangular, termen not oblique; in male with a narrow costal fold extending to middle; fuscous-whitish; a large, dark-fuscous, basal patch extending to $\frac{1}{4}$; some obscure fuscous irroration in disc; a large oval ring beneath apex close to termen slenderly outlined in fuscous; cilia dark fuscous, apices whitish, on tornus whitish. Hindwings with termen scarcely sinuate; fuscous; cilia whitish.

An obscure but peculiar species with unusual secondary sexual characters.

Queensland: Yeppoon, in October; one specimen.

Proschistis symploca, n. sp.

συμπλοκος, interwoven.

♂, 12 mm. Head whitish, on crown mixed with fuscous. Palpi $1\frac{1}{2}$; whitish mixed with fuscous. Antennae ochreous-whitish annulated with blackish; ciliations in male imperceptible. Thorax and abdomen fuscous. Legs fuscous; tarsi with obscure whitish annulations; posterior pair mostly whitish. Forewings moderate, posteriorly dilated, costa gently arched, apex obtuse, termen slightly oblique; in male without costal fold; whitish densely irrorated with fuscous, which tends to be arranged in transverse striae; costa shortly strigulated alternately fuscous and whitish; a large slightly darker basal patch from costa near base to disc at $\frac{1}{3}$, thence right-angled to mid-dorsum; median fascia narrow, obscure, constricted in disc, from costa beyond middle to dorsum before tornus; a fuscous apical spot and another, larger, oval, before termen; cilia fuscous. Hindwings with termen scarcely sinuate; pale grey; cilia pale grey.

The first Australian species of the genus. Markings on forewings are very obscure.

Queensland: Caloundra, in August; one specimen.

Laspeyresia sinapichroa, n. sp.

σιναπιχροος, mustard-coloured.

♂, 14 mm. Head and thorax ochreous-yellow. Palpi short (about 1), slender; pale ochreous. Antennae grey; in male thickened, ciliations imperceptible. Abdomen grey. Legs pale ochreous. Forewings suboval, costa nearly straight, apex rounded, termen obliquely rounded; ochreous-yellow; numerous fine fuscous dots on costa giving rise to fine broken transverse lines of darker ochreous; in postmedian area spaces between these lines are occupied by leaden-violet lines; cilia fuscous-grey with an interrupted blackish basal line. Hindwings with termen not sinuate; ochreous-grey; cilia pale grey with an ochreous-grey subbasal line.

Nearest *L. aulacodes*, Low.

Queensland: Dalby, in December; one specimen.

Fam. ELACHISTIDAE.

Labdia cyanogramma, Meyr.

L. euphrantica, Turn., is a synonym. This species is more variable than I had supposed.

North Queensland: Townsville. Queensland: Yeppoon, Brisbane, Mount Tambourine. New South Wales: Sydney.

Labdia aresta, n. sp.

ἀρεστος, pleasing.

♂, 10-11 mm. Head pinkish-white; face and palpi whitish. Antennae whitish; basal joint, two broad rings before middle, two broad rings beyond

middle, and a narrow subapical ring, blackish. Thorax pale pink with two longitudinal whitish lines. Abdomen greyish-ochreous; tuft large, whitish-ochreous. Legs ochreous-whitish; tibiae and tarsi annulated with fuscous. Forewings broadly lanceolate; pale pink; extreme base whitish, with a blackish subdorsal dot; a suffused, straight, transverse, whitish fascia at $\frac{1}{5}$, immediately preceded by a median blackish dot; a similar fascia at $\frac{2}{3}$, edged anteriorly by a blackish line; cilia pale pink, becoming whitish on dorsum. Hindwings lanceolate; pale grey; cilia 4, pale grey.

A beautiful species not like any other.

Queensland: Yeppoon, in October; two specimens.

Labdia phaeocala, n. sp.

φαιοκαλος, dark but comely.

♂, ♀, 10 mm. Head dark fuscous; face whitish. Palpi whitish; external surface of second joint, and sometimes also of terminal joint, fuscous. Antennae dark fuscous with very fine whitish rings. Thorax and abdomen dark fuscous. Legs dark fuscous; tibiae and tarsi with whitish rings. Forewings moderately narrow, apex pointed; ochreous-fuscous; a broad transverse fuscous fascia before middle, edged anteriorly and posteriorly by a transverse whitish line; apical part of disc irrorated with fuscous; a whitish costal dot at $\frac{5}{6}$; cilia fuscous, on apex paler with two short blackish bars. Hindwings lanceolate; grey, cilia 4, grey.

Queensland: Brisbane, in October; two specimens.

Pyroderces eupogon, n. sp.

εὐπωγων, well bearded.

♂, 14 mm. Head ochreous-whitish. Palpi with second joint strongly tufted beneath at apex; fuscous; middle and apex of second joint, and internal surface of terminal joint, except apex, ochreous-whitish. Antennae fuscous with obscure whitish annulations. Thorax fuscous; shoulder-flaps ochreous-whitish. Abdomen fuscous; base of dorsum ochreous tinged. Legs fuscous; posterior pair ochreous-whitish. Forewings moderately narrow, costa gently arched near base, thence straight, apex pointed, termen straight, strongly oblique; fuscous; a median streak from base, joining a moderate oblique fascia from $\frac{1}{6}$ costa to dorsum before middle, continued as a broad dorsal streak to termen, ochreous-whitish; a longitudinally oval, dark-fuscous spot in disc before middle, sharply defined except on costal aspect; a short, oblique, ochreous-whitish streak from costa at $\frac{5}{6}$; cilia fuscous, on dorsum grey. Hindwings lanceolate; grey; cilia 3, grey.

The genus *Pyroderces* has the same neuration as *Labdia,* but is distinguished by the rough-scaling of the forewings. The tufted palpi are unusual in the genus, but have been already noted in *P. pogonias,* Turn.

New South Wales: Mount Wilson (3,500 feet), in November; one specimen.

Stagmatophora niphocrana, n. sp.

νιφοκρανος, with snow-white head.

♂, 9 mm. Head and palpi white. Antennae white with fuscous annulations; basal joint somewhat expanded, wholly white. Thorax white; shoulder-flaps fuscous. Abdomen grey; tuft whitish-ochreous. Legs fuscous; posterior femora and tibial and tarsal annulations white. Forewings narrowly lanceolate; fuscous; costal edge whitish from $\frac{1}{3}$ to near apex; a white streak from base along dorsum and termen to apex, broader from base to $\frac{2}{5}$ dorsum, broader

again from tornus to apex, terminal portion split into two fine streaks by an intervening fuscous streak; a blackish streak mixed with some white scales from middle of dorsal streak towards apex; cilia fuscous with two whitish lines, on tornus and dorsum grey. Hindwings linear-lanceolate; grey; cilia 6, grey.

North Queensland: Kuranda, in June; one specimen.

Stagmatophora haploceros, n. sp.

ἁπλοκερως, with simple horns.

♂, 10 mm. Head and palpi white. Antennae with basal joint slightly enlarged; white, towards apex grey. Thorax white; shoulder-flaps fuscous. Abdomen grey. Legs fuscous; posterior pair whitish, tibiae and tarsi with fuscous annulations. Forewings lanceolate; dark fuscous; a broad white dorsal streak, expanded before and constricted at tornus, continued on termen nearly to apex, terminal part longitudinally bisected by a dark-fuscous line; a short oblique white streak on costa slightly beyond middle; cilia grey, bases dark fuscous beneath apex. Hindwings narrow-lanceolate; pale grey; cilia 6, pale grey.

Very like *S. niphocrana,* but distinguished by the antennae not being annulated with fuscous, and the white mark on costa of forewings.

Queensland: Yeppoon, in October; one specimen.

Cosmopteryx calliochra, n. sp.

καλλιωχρος, beautifully pale.

♂, ♀, 13-14 mm. Head whitish, crown tinged with orange, a red line above eyes. Palpi whitish; terminal joint with pale-fuscous subbasal and subapical rings. Antennae whitish, with several fuscous rings, which are better marked towards apex. Thorax orange-brown. Abdomen grey. Legs whitish-ochreous; anterior tibiae and all tarsi with fuscous rings. Forewings narrow, apex acute; orange-brown; a fine whitish line edged by some fuscous scales on fold from base to middle of wing; a fine whitish costal line from base, soon diverging from costa in an oblique curve to join previous line at $\frac{1}{4}$; a broad, very pale yellowish subapical transverse fascia, edged anteriorly by a whitish line, which is followed on costa by a short fuscous streak, and on dorsum by a silvery spot edged posteriorly with blackish; cilia whitish-ochreous. Hindwings narrow-lanceolate; pale-grey; cilia 8, grey-whitish.

Queensland: National Park (3,000 feet), in January; Bunya Mountains (3,000 feet), in January; five specimens.

Persicoptila anthophyes, n. sp.

ἀνθοφυης, brightly coloured like a flower.

♀, 13 mm. Head whitish; side-tufts ochreous. Palpi white, terminal joint ochreous tinged. Antennae ochreous. Thorax reddish-ochreous, mixed with whitish. [Abdomen broken off.] Legs whitish, annulated with ochreous; tufts on posterior tibiae very large, internally pinkish with a few fuscous scales, externally reddish-ochreous crossed by a white band. Forewings narrow, apex obtuse; 7 and 8 stalked out of 6, 7 to costa; basal half pink tinged with ochreous; a whitish transverse fascia just beyond middle; thence reddish-ochreous with some pinkish and whitish scales; a fuscous discal dot, edged with whitish, at $\frac{3}{4}$; extreme apex whitish-ochreous; a suffused fuscous spot on tornus extending into cilia; cilia reddish-ochreous, becoming grey on dorsum. Hindwings lanceolate; grey-whitish; cilia grey-whitish.

Queensland: Yeppoon, in November; one specimen. Type in Coll. Goldfinch.

Limnoecia polycydista, n. sp.

πολυκυδιστος, most glorious.

♂, 21-22 mm. Head orange; sometimes blackish in centre. Palpi pale orange; terminal joint blackish. Antennae blackish with a broad white ring beyond middle and another at apex; ciliations in male $\frac{1}{2}$. Thorax black. Abdomen ochreous; apex and underside dark fuscous; tuft ochreous. Legs blackish; tibiae and tarsi ringed with whitish or pale ochreous; dorsal hairs of posterior tibiae orange. Forewings elongate, costa straight, apex obtuse; black; two orange transverse fasciae; first rather broad, subbasal, complete or not quite reaching dorsum; second beyond middle, not reaching dorsal edge; an orange costal spot beyond $\frac{3}{4}$, sometimes connected with a smaller orange spot on tornus; cilia blackish, becoming grey on dorsum, at apex apical half pale ochreous. Hindwings lanceolate; dark grey; cilia $2\frac{1}{2}$, pale ochreous; around apex grey.

Queensland: Dalby, in December; Bunya Mountains (3,000 feet), in January; two specimens.

Limnoecia stenosticha, n. sp.

στενοστιχος, narrow lined.

♂, ♀, 14 mm. Head ochreous-whitish. Palpi whitish; terminal joint fuscous anteriorly. Antennae with a slight basal pecten; dark fuscous; basal joint, two or three rings beyond middle, two rings before apex, and extreme apex whitish. Thorax pale fuscous; shoulder-flaps whitish. Abdomen grey; tuft whitish-ochreous. Legs fuscous, irrorated, and tibiae and tarsi annulated, with pale ochreous. Forewings moderate, apex pointed; fuscous, towards apex suffused with pale ochreous; an oblique whitish line from costa near base to $\frac{1}{3}$ dorsum, followed by some whitish suffusion; a similar line from $\frac{2}{5}$ costa to $\frac{2}{3}$ dorsum, slightly sinuate; a whitish line from tornus parallel to termen, reaching half across disc; two short inwardly-oblique white streaks from costa before apex; cilia on costa and apex with bases ochreous, apices dark fuscous forming a slight hook, on termen bases ochreous, apices whitish, junction defined by a fine dark-fuscous line, on dorsum grey. Hindwings lanceolate; grey; cilia 4, pale grey.

Queensland: Coolangatta, in September; National Park (3,000 feet), in November; two specimens.

Fam. HELIODINIDAE.

Gen. Isorrhoa, Meyr.

I think *Aeoloscelis hydrographa*, Meyr., and *A. ancistrota*, Turn., should be referred to this genus. They appear to be closely allied to *I. loxoschema*, Turn., and the following species. All, I think, have 6, 7, 8 of forewings stalked.

Isorrhoa emplecta, n. sp.

ἐμπλεκτος, intricate.

♂, ♀, 14-18 mm. Head whitish. Palpi white; second joint with apical, terminal joint with antemedian and subapical dark-fuscous rings. Antennae whitish, annulated with dark fuscous. Thorax whitish, with a fuscous spot on each shoulder. Abdomen ochreous-whitish. Legs whitish; tibiae and tarsi with dark-fuscous rings; posterior tibiae with dense whorls of scales on dorsum, pinkish, apices blackish. Forewings narrow, apices obtusely pointed; white, markings brownish-ochreous, mixed with dark fuscous; a basal patch extending to $\frac{1}{5}$, its edge angled outwards; a large quadrate costal spot before middle, from which proceeds a line to tornus edged above with dark fuscous; dorsal spots before and beyond middle sometimes connected with the preceding, the latter containing a dark-fuscous bar; a suffused line beneath costa from $\frac{2}{3}$ to apex; a

short dark-fuscous terminal line; cilia brownish-ochreous, on apex with a median fuscous line; on dorsum grey. Hindwings lanceolate; grey; cilia 3, ochreous-whitish.

Queensland: Bunya Mountains (3,000 feet), in January; five specimens.

Isorrhoa ochrochyta, n. sp.

ὠχροχυτος, pale suffused.

♀, 20 mm. Head white. Palpi whitish; terminal joint fuscous anteriorly. Antennae grey-whitish. Thorax fuscous mixed with dark fuscous, and in centre with white. Abdomen fuscous on dorsum, apices of segments barred with reddish-ochreous and whitish; tuft grey-whitish; underside white. Legs whitish; tibiae and tarsi with dark-fuscous rings; posterior tibiae and tarsi ochreous, with dense whorls of dark-fuscous scales. Forewings very narrow, apex acute; fuscous, partly suffused with whitish towards base and apex; cilia grey. Hindwings narrow-lanceolate; grey; cilia 8, grey.

Queensland: Bunya Mountains (3,000 feet), in January; one specimen.

Isorrhoa euzona, n. sp.

εὐζωνος, well banded.

♀, 13 mm. Head and thorax fuscous with brassy reflections; face and palpi brassy-whitish. Antennae fuscous. Abdomen dark fuscous; tuft ochreous-whitish. Legs whitish-ochreous; tibiae and tarsi with fuscous rings, more broadly developed on posterior pair. Forewings moderately narrow, apex pointed; fuscous with brassy reflections; a broad transverse subbasal yellow fascia; a rather large triangular yellow tornal spot; cilia fuscous. Hindwings lanceolate; grey; cilia 5, grey.

Queensland: National Park, at low level, in November; one specimen.

Gen. **Aenicteria**, nov.

αἰνικτηριος, propounding riddles.

Tongue absent. Labial palpi long, ascending, recurved; second joint very long, smooth, slightly expanded with scales at apex, terminal joint much shorter than second, smooth, slender, acute. Antennae with some rough hairs around base; in male very minutely ciliated. Posterior tibiae with a thick clothing of very long hairs on dorsum, and a short terminal whorl of scales; tarsal joints with very short terminal whorls of scales. Hindwings with 2 and 3 connate, 4 absent.

I have not been able to make out the neuration of the forewings, but there is little room for doubt that this is a new genus allied to *Calicotis* and *Pachyrhabda*.

Aenicteria termiticola, n. sp.

termiticolus, living with termites.

♂, 14 mm. Head, palpi, antennae, and thorax white. Abdomen grey; tuft ochreous-whitish. Legs whitish; posterior tibiae with fuscous rings. Forewings narrow, costa straight, apex obtuse; white; markings fuscous; a suffused spot on dorsum before middle; a spot on tornus; a dot on costa at $\frac{2}{3}$; a costal spot on $\frac{4}{5}$ opposite another on middle of termen; a dark-fuscous apical dot; cilia white with a dark-fuscous costal line ending in an apical hook. Hindwings lanceolate; grey; cilia $2\frac{1}{2}$, grey.

North Queensland: Meringa, near Cairns, in September; one specimen received from Mr. F. H. Taylor with the note: "From inside of stump infested with termites." This probably points to some strange life history, which would be well worth investigation.

Gen. DOLOPHROSYNE, Drnt.

Nov. Zool., 1919, p. 120.

Head smooth. Tongue present. Palpi moderate, curved, ascending, about reaching vertex; second joint shortly rough-scaled; terminal joint short, acute. Maxillary palpi obsolete. Thorax smooth. Abdomen with a large apical tuft of broad scales. Femora thickened with long scales, those of posterior pair partly divided into two tufts from origin of spurs; posterior tarsi with short bristles on apices of joints. Forewings narrow; all veins present, 2 from $\frac{7}{8}$, 3, 4, 5 approximated from angle, 7 and 8 stalked, 7 to costa. Hindwings over one, mostly hyaline; all veins present, 2 from $\frac{3}{4}$, 3 and 4 short-stalked, 5 separate, parallel, 6 and 7 stalked, 8 separate, not concealed.

A curious genus with close general resemblance to the Aegeriadae, but the structure of the hindwings is different. It shows some but not close relationship to *Pseudaegeria,* Wlsm.

DOLOPHROSYNE BALTEATA, Drnt.

Ibid, p. 121.

♂, 20 mm. Head and palpi ochreous-fuscous. Antennae dark fuscous; in male slightly dentate in basal half, shortly ciliated ($\frac{2}{3}$). Thorax dark fuscous; two small posterior tufts of fine ochreous hairs. Abdomen blackish; third and sixth segments almost entirely ochreous on dorsum; posterior edge of fourth and fifth segments on dorsum orange, laterally expanded; tuft three-lobed, central lobe pale ochreous, lateral lobes dark fuscous. Legs dark fuscous; tarsi ochreous tinged; posterior femora with a median dorsal white spot. Forewings narrow, oblong, costa sinuate, apex and termen rounded; dark fuscous; distal $\frac{2}{3}$ of costal edge ochreous; a small, suffused, longitudinal, median, ochreous mark at $\frac{2}{3}$; cilia fuscous with an interrupted basal whitish line. Hindwings about 2, apex round-pointed; hyaline; colourless; veins clothed with scales, ochreous, except towards margin, where it is replaced by blackish; a blackish terminal line; cilia blackish.

Queensland: Yeppoon, in October; one specimen. Mr. Durrant's specimens came from Duaringa.

Fam. GLYPHIPTERYGIDAE.

EUTHORYBETA XANTHOPLACA.

♂. *Euthorybeta xanthoplaca,* Turn., Proc. Linn. Soc. N.S.W., 1913, p. 201.

♀. *E. ochroplaca,* Turn., *ibid.*

I find that my type of *E. xanthoplaca* is a male, as Mr. Meyrick suggests. The antennae in this sex are thickened and very shortly ciliated ($\frac{1}{4}$). Mr. Meyrick is probably correct in suggesting that *E. ochroplaca* is the female of this species.

Queensland: Stradbroke Island, Stanthorpe. New South Wales: Illawarra, Lawson.

GLYPHIPTERYX METEORA, Meyr.

G. chalceres, Turn., is a synonym; the points on which I relied for differentiation are merely varietal.

Queensland: Brisbane, Mount Tambourine, National Park (3,000 feet). New South Wales: Murrurundi, Bulli, Bathurst. Victoria: Melbourne, Gisborne. Tasmania: Launceston, Deloraine, Campbelltown, Hobart. South Australia: Mount Lofty, Wirrabara.

Glyphipteryx lamprosema, n. sp.

λαμπροσημος, brilliantly marked.

♂, 10-12 mm. Head and thorax brassy-fuscous. Palpi slightly rough-scaled beneath; white, four rings and extreme apex blackish. Antennae fuscous. Abdomen dark fuscous; apex of tuft whitish. Legs dark fuscous; posterior

tibiae and all tarsi white-ringed. Forewings moderate, costa slightly arched, apex rounded, termen nearly straight, oblique; 7 and 8 connate or short-stalked; brassy-fuscous; two whitish dorsal spots at $\frac{1}{5}$ and middle; the first outwardly oblique, prolonged across fold, and ending in a point beneath costa; the second short, transverse; six fine costal streaks and other streaks and spots brilliant metallic-violet or green; first costal streak from $\frac{1}{4}$, strongly oblique, joining second dorsal spot to form a complete fascia; second, third, and fourth oblique, not reaching half across disc; fifth and sixth short, arising from white dots in cilia near apex, more transverse, sixth ending in terminal incision; a discal spot below and between second and third streaks; an erect streak from tornus ending below and between third and fourth streaks; a short streak on lower part of termen; two longitudinal black streaks, the first connecting apices of fourth and fifth costal streaks, the second connecting apex of third costal streak with upper end of terminal streak, but cut by tornal streak; cilia with bases brassy-fuscous, apices grey but white on apex and incision. Hindwings broadly lanceolate; grey; cilia 1, grey.

Nearest *G. amblycerella*, Meyr., and *G. asteriella*, Meyr.

New South Wales: Ebor (4,000 feet), in January; four specimens.

Gen. **Agiton,** nov.

ἀγειτων, without a neighbour.

Head smooth. Tongue present but weak. Palpi curved, ascending, diverging, not reaching vertex, smooth-scaled; second joint moderate; terminal joint broad, but compressed antero-posteriorly, pointed. Maxillary palpi obsolete. Antennae short, less than $\frac{1}{2}$; in male simple. Thorax smooth. Posterior tibiae shortly rough-haired on dorsum; spurs long. Forewings narrow; 2 from shortly before angle, 5 from near middle of cell, 7 and 8 coincident and running to costa, 11 from $\frac{2}{3}$. Hindwings less than 1, spathulate; 2 and 3 stalked, 4 absent, 6 absent.

A curious genus not near any other.

Agiton idioptila, n. sp.

ἰδιοπτιλος, with peculiar wings.

♂, 12-14 mm. Head and palpi ochreous-whitish. Antennae grey. Thorax ochreous-fuscous. Abdomen fuscous. Legs ochreous-whitish. Forewings elongate-triangular, strongly dilated posteriorly, costa straight nearly to apex, but arched before apex, apex acute, termen sinuate, oblique; ochreous-fuscous; four, narrow, elongate, ochreous-whitish, costal spots, first before middle, second beyond middle, third at $\frac{3}{4}$, fourth midway between this and apex; a blackish ante-apical dot in disc, edged anteriorly with white; cilia fuscous. Hindwings about $\frac{2}{3}$, strongly dilated posteriorly, apex acute; fuscous; cilia 1, fuscous.

The shape of wings, and especially of hindwings, is peculiar.

Queensland: National Park (2,000 to 3,000 feet), in December and January; six specimens.

Fam. HYPONOMEUTIDAE.

Gen. **Aictis,** nov.

ἀϊκτις, unapproachable.

Tongue present. Antennae of male simple. Posterior tibiae smooth. Forewings with all veins present and separate, 2 from near angle, 7 to apex, 11 from middle of cell. Hindwings with all veins present; 6 and 7 connate, gradually diverging.

Differs from *Lactura*, Wlk., in the close approximation of 6 and 7 of hindwings. In my example the palpi are unfortunately broken off; probably they are as in that genus.

Aictis erythrozona, n. sp.

ερυθροζωνος, red-banded.

♂, 20 mm. Head and antennae blackish. Thorax blackish with a red spot on each shoulder prolonged ventrally. Abdomen blackish. Legs blackish; bases of first tarsal joints white. Forewings elongate-oval, costa gently arched, apex rounded, termen very obliquely rounded; dark fuscous; a broad red subbasal fascia not reaching costal edge; cilia dark fuscous. Hindwings elongate-ovate; fuscous; basal red fascia not reaching dorsum; cilia fuscous.

North Queensland: Kuranda; one specimen received from Mr. F. P. Dodd.

Gen. LACTURA, Wlk.

In the forewings 7 and 8 may be stalked or separate. This is a good specific character, but, as Meyrick has pointed out, should not be used for generic separation. In the hindwings 4 and 5 may be stalked, connate, or separate; here the structure is not always constant in the one species. Meyrick is, therefore, certainly correct in merging *Mieza,* Wlk., with this genus, but the name *Lactura* has priority.

Lactura panopsia, n. sp.

πανοψιος, very conspicuous.

♂, 24-28 mm. Head orange; face white. Palpi $1\frac{1}{2}$; red; terminal joint whitish sometimes tinged with red. Antennae whitish; in male minutely ciliated. Thorax purple; five whitish spots, the first four paired, the fifth posterior. Abdomen pale reddish. Legs whitish-ochreous; anterior pair, and apical spots on femora and tibiae of middle and posterior pairs red. Forewings suboval, costa strongly arched, apex rounded, termen slightly rounded, oblique; 7 and 8 stalked, 7 to apex; whitish-ochreous with red streaks on dorsum and between veins; a wavy purple line from base of costa to mid-dorsum, and another from base of dorsum to midcosta, intersecting near base; a similar line from mid-dorsum to $\frac{3}{4}$ costa, connected firstly by a line with midcosta, secondly with tornus, thirdly with the upper end of a terminal line from beneath apex to tornus; cilia pale reddish. Hindwings broad; 4 and 5 widely separate (3 examples) or nearly connate (one example); pale reddish; cilia pale reddish.

Not unlike *L. parallela,* Meyr.

Queensland: Bunya Mountains (3,000 feet), in January; four specimens.

Gen. Palleura, nov.

παλλευρος, all smooth.

Tongue absent. Palpi long, smooth, slender, acute, drooping. Posterior tibiae smooth. Forewings with 7 and 8 stalked, 7 to costa, 9 absent, 11 from $\frac{1}{4}$. Hindwings with 2 from $\frac{3}{4}$, 3, 4, 5, 6, and 7 separate, parallel.

Palleura nitida, n. sp.

nitidus, shining.

♀, 14 mm. Head, palpi, and thorax white. Antennae white; apices of joints fuscous. [Abdomen broken off.] Legs white; fuscous rings on tarsi and apices of tibiae. Forewings moderate, costa gently arched, apex pointed, termen nearly straight, oblique; smooth and lustrous; white with ochreous-fuscous strigulae forming numerous fine transverse lines; near apex these become fuscous; a fuscous discal spot before middle; cilia pale fuscous with a dark subapical line. Hindwings ovate-lanceolate; shining white; cilia 1, white.

Queensland: Bunya Mountains (3,000 feet), in January; one specimen.

Fam. GRACILARIADAE.

Acrocercops antigrapha, n. sp.

ἀντιγραφος, copied.

♂, ♀, 8-10 mm. Head and thorax white. Palpi white; second joint with apical, terminal joint with subapical, fuscous rings. Antennae grey. Abdomen grey; underside white with transverse fuscous bars. Legs white; tibiae and tarsi with fuscous rings. Forewings narrow, apex obtuse; fuscous-brown; four white transverse fasciae partly edged with dark fuscous; first subbasal; second before middle; third at $\frac{3}{4}$, usually as broad as the two preceding, but sometimes narrower towards costa; fourth narrow, subapical; a fuscous apical spot; cilia grey, on terminal and costal ends of fourth fascia white. Hindwings lanceolate; grey; cilia 6, grey.

This species, together with *A. autadelpha,* Meyr.; *A. macaria,* Turn.; *A. tetrachorda,* Turn.; and *A. symphyletes,* Turn., are all very similar and need careful discrimination.

Queensland: National Park (3,000 feet), in October and November; seven specimens.

Acrocercops chalcea, n. sp.

χαλκεος, brassy.

♂, 10 mm. Head and thorax white. Palpi white; second joint with an apical fuscous ring. Antennae dark grey. Abdomen dark grey; under surface white. Legs whitish; tibiae and tarsi with fuscous rings. Forewings narrow, apex obtuse; pale brassy; a narrow white transverse fascia at $\frac{3}{4}$, partly edged with blackish posteriorly; beyond this disc is rather darker and not metallic; a second narrow white subapical fascia preceded by a minute blackish dot on costa and dorsum; a large oval oblique black posterior spot; cilia grey, on apex white with fuscous apices. Hindwings linear-lanceolate; grey; cilia 10, grey.

Queensland: National Park (3,000 feet), in November; one specimen.

ACROCERCOPS PARALELLA, Turn.

This and the following two species, which were described in my first entomological paper (Trans. Roy. Soc. S. Austr., 1894), are very closely allied. The types of the latter two have been, unfortunately, lost, and the original descriptions are defective in some particulars. I propose, therefore, to supplement them.

♂, ♀, 8-10 mm. Forewings grey; a broad white dorsal streak from base terminating abruptly at tornus, thickened at $\frac{3}{4}$ dorsum for a short distance, and again at extremity, its upper edge partly defined by blackish; a narrow white costal streak from base, black-edged beneath, leaving costa about middle and thence doubly black-edged, running close beneath costa to $\frac{3}{4}$, there obtusely bent and oblique to a white dot on mid-termen; a short, similar, parallel streak from costa to termen succeeds this; cilia white with a transverse blackish bar and apices grey at apex of wing, on dorsum grey.

North Queensland: Cairns. Queensland: Nambour, Caloundra, Brisbane, Coolangatta.

ACROCERCOPS PLEBEIA, Turn.

♂, ♀, 7-10 mm. Forewings grey; a broad white dorsal streak from base to tornus, where it is indented, but nearly or quite continuous with a white streak along termen, its upper edge straight and not black-edged, not enlarged except just before tornus slightly; a very narrow, white, costal streak from $\frac{1}{4}$ to $\frac{3}{4}$, not black-edged; two, fine, oblique, white, doubly black-edged streaks from costa at $\frac{3}{5}$ and before apex to termen; cilia white with a transverse blackish bar and apices blackish at apex of wing, on dorsum grey.

Queensland: Brisbane, Toowoomba, Warwick, Stanthorpe. New South Wales: Sydney (probably accidentally introduced), where it has lately appeared in such numbers as to defoliate its food-plant *Acacia podalyriaefolia*.

Acrocercops unilineata, Turn.

♂, 7-9 mm. Forewings grey; a white streak along dorsum and termen from base, indented at tornus, upper edge straight, not black-edged; no costal streak; a fine, longitudinal, interrupted, white streak beneath apical $\frac{1}{6}$ of costa, edged beneath with black; cilia white, a blackish apical hook, and apices black at apex of wing.

Queensland: Brisbane, Coolangatta.

Acrocercops leucomochla, n. sp.

λευκομοχλος, white-barred.

♂, 9 mm. Head white. Palpi white; apex of second and base of terminal joint narrowly fuscous. Antennae fuscous; white at base. Thorax white; shoulders grey. Abdomen dark grey. Legs dark grey; ventral surface white; tarsi with fine white annulations. Forewings dark grey; a broad, white, dorsal streak from base, where it is half breadth of wing, continued along termen, indented at tornus, its upper edge straight, not black-edged; a very fine, oblique, black-edged, white streak from beneath $\frac{3}{4}$ costa to dorsal streak at tornus; a large triangular white terminal spot continuous with dorsal streak, connected with costa before apex; an oblique black subapical bar, leaving extreme apex white; cilia white, with a short transverse bar at apex of wing, on dorsum grey. Hindwings linear-lanceolate; grey; cilia 12, grey.

Also nearly related to the three preceding species.

Queensland: One specimen, which emerged in November, from the blotched leaf of a scrub tree or creeper found at Yeppoon.

Parectopa miltopepla, n. sp.

μιλτοπεπλος, robed in red.

♂, 12 mm. Head whitish. Labial palpi whitish; basal half of second joint red. Maxillary palpi red. Antennae whitish. Thorax red. Abdomen grey. Legs red; posterior pair and all tarsi whitish. Forewings narrow, apex obtuse; bright red; four elongate, whitish, partly yellowish-tinged, costal spots partly edged with blackish; first small, subbasal; second larger at $\frac{1}{8}$; third from $\frac{1}{4}$ projecting obliquely into disc posteriorly; fourth very long, from $\frac{3}{8}$ to $\frac{3}{4}$, bisected by a red line, continued posteriorly beneath costa for a short distance; a black, subapical, costal spot, preceded by a minute whitish dot in disc; five dorsal spots, yellow except the last, which is white; first at $\frac{1}{6}$, second at $\frac{1}{3}$, third at middle, fourth at $\frac{2}{3}$, fifth on tornus; cilia whitish with a bright-red median line. Hindwings narrow-lanceolate; grey; cilia grey, on dorsum reddish tinged.

This belongs to the *P. formosa* group; it is nearest *P. ageta*, Turn., but very distinct.

North Queensland: Meringa, near Cairns, in January; one specimen received from Mr. F. H. Taylor. A better example from the same locality taken by Mr. G. M. Goldfinch shows that the cilia of forewings are crimson.

Fam. PLUTELLIDAE.

Paraphyllis dianipha, n. sp.

διανιφος, snow-white right through.

♂, 14-16 mm. Head and palpi white. Antennae pale grey; basal joint white. Thorax fuscous; in male with a white anterior tuft directed backwards

beneath. Abdomen grey; tuft whitish. Legs fuscous; posterior pair whitish. Forewings elongate-oval, apex pointed; costal area grey with some whitish suffusion towards base; a white median streak from base to apex; a fuscous streak from middle of base to tornus, thence continued along termen, not reaching apex; a broad, white, dorsal streak narrowing to a point at tornus; cilia grey, paler towards tornus, on apex and tornus white. Hindwings broadly lanceolate; grey; cilia $1\frac{1}{2}$, pale grey.

New South Wales: Mittagong, in November; two specimens received from Mr. G. M. Goldfinch, who has the type.

Fam. TINEIDAE.

Leucoptera euryphaea, n. sp.

εὐρυφαιος, broadly fuscous.

♂, 7 mm. Head with rough hairs on anterior part of crown projecting forwards; white. Antennae pale grey. Thorax white. Abdomen pale grey. Legs white. Forewings moderately narrow, apex acute; white; a broad fuscous longitudinal streak from $\frac{1}{3}$ costa, at its origin touching fold, but gradually narrowing to apex, leaving costal edge partly white; a rather large brassy spot on termen, edged anteriorly with fuscous; cilia white, on costa fuscous, on apex basal $\frac{2}{3}$ dark fuscous. Hindwings lanceolate; white; cilia 6, white.

Queensland: Bunya Mountains (3,000 feet), in January; one specimen.

Phyllocnistis ephimera, n. sp.

ἐφιμερος, delightful.

♂, ♀, 6-7 mm. Head, palpi, and thorax white. Antennae grey becoming whitish towards base. Abdomen pale grey. Legs whitish. Forewings dilated posteriorly, apex obtuse; white; a fine fuscous streak from costa beyond middle, strongly outwardly oblique, joined at an acute angle in middle of disc by a similar streak from dorsum before tornus, disc anterior to these suffused with pale ochreous-fuscous; a transverse streak from $\frac{3}{4}$ costa joins apex of angle formed by the two preceding; two similar converging streaks from costa before apex; these three streaks extend also through costal cilia; cilia whitish, on apex a black dot with two diverging fuscous streaks, on termen basal halves pale ochreous-fuscous limited by a fine fuscous line, on dorsum pale grey. Hindwings narrow-lanceolate; pale grey; cilia 8, pale grey.

North Queensland: Kuranda, in June. Queensland: National Park (3,000 feet), in October. Three specimens.

Lyonetia lechrioscia, n. sp.

λεχριοσκιος, obliquely shaded.

♂, 10 mm. Head and thorax pale ochreous-fuscous; face and palpi white. Antennae grey; basal joint white. Abdomen grey-whitish. Legs whitish; tarsi with blackish rings. Forewings narrow, apex obtuse; ochreous-whitish; rather broadly suffused, pale ochreous-fuscous lines; a longitudinal median line from base to apex, its basal portion suffusedly connected with dorsum; three strongly oblique lines from costa at $\frac{2}{5}$, $\frac{3}{5}$, and $\frac{4}{5}$ running into median line; two similar lines from dorsum beyond middle; a black apical dot; cilia on costa whitish with two fine fuscous bars, on apex whitish with a terminal fuscous bar, beneath apex pale ochreous-fuscous, on dorsum grey. Hindwings linear-lanceolate; grey; cilia 10, grey.

Queensland: National Park (3,000 feet), in November; one specimen.

Cateristis triradiata, n. sp.

triradiatus, three-rayed.

♂, 9 mm. Head and palpi white. Antennae grey, towards base white. Thorax white. Abdomen dark grey. Legs grey. Forewings elongate, apex rounded; white; markings pale brown speckled with black; a dot on dorsum near base, a second beyond this on fold, a third in disc at $\frac{1}{3}$; an outwardly oblique line from $\frac{2}{5}$ costa, joined in mid-disc by a similar line from mid-dorsum, thence produced in mid-disc to above tornus, forming a triradiate figure; a transverse subterminal line confluent with the preceding; cilia whitish, around apex with median and apical black lines. Hindwings narrow-lanceolate; pale grey; cilia 6, pale grey.

This appears to agree with Meyrick's definition of the genus. It is allied to *Leucoptera,* but somewhat more primitive.

New South Wales: Mount Wilson (3,500 feet), in November; one specimen.

Bucculatrix gossypii, n. sp.

gossypium, cotton.

♂, ♀, 7-10 mm. Head and thorax whitish. Antennae whitish-grey. Abdomen pale grey. Legs grey; posterior pair whitish. Forewings elongate-oval, apex round-pointed; whitish, in female whitish-grey; apical $\frac{1}{4}$ suffused with grey; four black discal dots, two at $\frac{1}{3}$, two at $\frac{2}{3}$, two subcostal, two just beneath fold, but these are not always all present; cilia whitish-grey with basal and subapical lines of black irroration. Hindwings lanceolate; grey; cilia 3, whitish-grey.

This is not the same as *B. loxoptila,* Meyr., which also feeds on cotton, and occurs in India and Africa.

Queensland: Rockhampton, in January and February; six specimens from larvae on cotton.

Opogona confinis, n. sp.

confinis, adjacent, similar.

♂, 15 mm. Head and thorax yellow; face and palpi whitish. Antennae pale yellow; basal joint fuscous. Abdomen grey. Legs whitish; anterior pair, except coxae, fuscous. Forewings elongate, apex acute; a fuscous costal streak from base to $\frac{2}{3}$, narrow throughout, gradually tapering to a point posteriorly; a rather broad terminal line from apex to tornus, fuscous with opalescent reflections; cilia fuscous, on costa yellow. Hindwings lanceolate; grey; cilia 3, grey.

Queensland: National Park (2,500 feet), in November; one specimen taken in open Australian forest.

Dryadaula brontoctypa, Meyr.

Queensland: Brisbane, Toowoomba. New South Wales: Sydney.

Dryadaula glycinopa, Meyr.

This might be mistaken for *brontoctypa,* Meyr. (now referred by Meyrick to *Dryadaula),* but the markings are pale yellow, and the costal streaks fuscous only, if at all, on costal margin. The curious ridge of blackish scales on the underside of the hindwings of that species will readily distinguish it.

Queensland: Mount Tambourine, in September and October; National Park (2,500-3,500 feet), in December, January, and March. New South Wales: Ebor, in January; Bulli; Katoomba.

Erechthias acontotypa, n. sp.

ἀκοντοτυπος, marked with darts.

♂, 13 mm. Head, palpi, and antennae white. Thorax white with five dark-fuscous dots, two anterior, two median, and one posterior. Abdomen fuscous; beneath whitish. Legs whitish; anterior pair fuscous; apical half of middle tarsi fuscous. Forewings elongate, apex acute; white; markings dark fuscous; two very oblique costal streaks, first from before middle, second from $\frac{2}{3}$; a spot on dorsum near base, a short oblique streak shortly beyond this, and a second streak from $\frac{1}{3}$, produced in disc and confluent with a tornal spot; a short, fine, black streak running longitudinally into apex; cilia white, on costa with a brown basal line, which ends in an apical hook. Hindwings broadly lanceolate; pale grey; cilia 2, pale grey.

Queensland: Brisbane, in November; one specimen.

Narycia stenomochla, n. sp.

στενομοχλος, narrowly barred.

♂, 18 mm. Head white. Palpi and antennae fuscous. Thorax dark fuscous. Abdomen pale grey; apical segments and tuft pale ochreous. Legs fuscous; posterior pair whitish-ochreous. Forewings suboval, costa rather strongly arched, apex round-pointed, termen very obliquely rounded; 7 absent; ochreous-whitish; markings and a few fine transverse strigulae fuscous; an outwardly curved line or narrow fascia from $\frac{1}{3}$ costa to mid-dorsum; a narrow fascia from $\frac{2}{3}$ costa to above tornus, bent in middle and slightly enlarged above bend; a subapical costal spot formed by several conjoint strigulae; cilia whitish, a fuscous bar from lower end of fascia. Hindwings and cilia pale grey.

Queensland: National Park (2,500 feet), in November; one specimen. I have also two female examples taken in the same locality, which are probably the same species. In them the forewings are whiter and the fasciae broader.

Gen. ARCHYALA, Meyr.

Trans. N. Z'land Inst., 1889, p. 159.

Head loosely haired. Antennal pecten sometimes present. Labial palpi with second joint rough-scaled beneath; terminal joint broad, smooth, acute, compressed antero-posteriorly. Maxillary palpi long, folded. Forewings with all veins present; 5 and 6 stalked. Hindwings ovate-lanceolate; all veins present and separate.

Type, *A. paraglypta,* Meyr., from New Zealand.

Archyala dromaea, n. sp.

δρομαιος, an agile runner.

♂, 10 mm. Head ochreous-brown; face whitish-ochreous. Palpi whitish-ochreous with a few fuscous scales. Antennae whitish-ochreous, with black annulations. Thorax ochreous-brown. Abdomen dark gey. Legs whitish-ochreous; tibiae and tarsi annulated with blackish. Forewings narrow, posteriorly dilated, apex rounded; ochreous-brown irrorated throughout with dark fuscous; by coalescence this forms several, short, oblique, costal streaks, of these one more distinct runs from $\frac{1}{6}$ costa to fold, another from $\frac{1}{3}$ costa is prolonged to mid-dorsum, and another broader from beyond middle of costa to mid-disc; cilia pale ochreous-brown with basal, median, and apical dark-fuscous lines. Hindwings broadly lanceolate; grey; cilia 1, grey.

Mr. Meyrick kindly determined the genus for me. *Archyala* was instituted for three New Zealand species, to which he has lately added a fourth from

Darwin, North Australia. I can find no antennal pecten in my examples, but its absence does not justify generic separation.

Queensland: National Park (2,000-2,500 feet), in December; three specimens, of which one is in Coll. Meyrick.

Gen. Crypsithyris, Meyr.

Head rough-haired. Labial palpi moderately long, slender, acute, porrect, diverging. Maxillary palpi long, folded. Antennae about 1; in male simple. Forewings with a large fovea in cell on underside; its base naked; all veins present, 5 and 6 stalked. Hindwings lanceolate; all veins present and separate.

I have not seen Meyrick's description, and have drawn up this diagnosis from the Queensland species. It appears allied to *Monopis,* Hb., but differs in the neuration of forewings.

Crypsithyris illaetabilis, n. sp.

illaetabilis, gloomy.

♂, 12 mm. Head and thorax ochreous-brown. Palpi fuscous. Antennae grey. Abdomen grey. Legs ochreous-whitish; anterior pair fuscous. Forewings elongate, apex pointed; ochreous-whitish with fairly general fuscous irroration; two elongate fuscous spots on fold, and a third in centre of disc; an ill-defined fuscous streak on termen; cilia ochreous-whitish with a few fuscous points. Hindwings lanceolate; pale grey; cilia 3, pale grey.

Queensland: Brisbane, in October; two specimens, of which one is in Coll. Meyrick.

I am indebted to Mr. Meyrick for the generic determination of this species also. He informs me that *Crypsithyris* is a genus of some extent in India and Africa.

Tinea peristilpna, n. sp.

περιστιλπνος, with glittering margin.

♂, ♀, 12-14 mm. Head and palpi whitish-brown. Antennae fuscous. Thorax and abdomen dark fuscous. Legs fuscous; middle and posterior tarsi with whitish rings. Forewings narrow-oval, apex pointed; fuscous; a pale-yellow fascia from $\frac{1}{6}$ costa to $\frac{1}{3}$ dorsum, narrow from costa to middle, thence broadly expanded to dorsum; six slender whitish costal streaks, first from $\frac{1}{3}$ reaching half across disc, the remainder nearly equidistant and shorter, the sixth subapical, minute, a small yellowish dorsal spot before tornus from which proceeds a fine whitish streak almost reaching second costal streak; a similar streak from tornus almost reaching third costal streak; a broad black terminal line containing five shining white marginal spots; cilia fuscous. Hindwings elongate-ovate; grey, becoming paler towards base; cilia $\frac{2}{3}$, pale grey.

Queensland: National Park (4,000 feet), in November. This beautiful and distinct species has very much the appearance and flight of a *Glyphipteryx.* I took four specimens one afternoon flitting round the mossy boles of the Antarctic Beech.

Tinea ecdela, n. sp.

ἐκδηλος, conspicuous.

♂, 14 mm. Head and antennae dark fuscous. Palpi whitish. Thorax brassy-fuscous. Abdomen fuscous. Legs whitish-ochreous with some fuscous suffusion. Forewings narrow-oval, apex acute; brassy-fuscous with some dark-fuscous irroration, markings yellow edged with dark fuscous; a very broad oblique triangle on dorsum from near base to middle, its apex nearly reaching costa at $\frac{1}{3}$; six very short

broad oblique costal streaks from middle to apex; a large elongate longitudinally-oval spot from above and before tornus almost to terminal edge; cilia fuscous with a pale-yellow bar beneath apex. Hindwings broadly lanceolate; ochreous; apical third fuscous; cilia 1, ochreous, around apex fuscous.

Allied to *T. pterocosma*, Meyr.

Queensland: National Park (3,000 feet), in November; one specimen.

Tinea trissoleuca, n. sp.

τρισσολευκος, triply white.

♀, 10 mm. Head white. Palpi fuscous. Antennae grey. Thorax white; shoulders blackish. Abdomen grey. Legs whitish; anterior and middle tibiae and tarsi with blackish rings. Forewings elongate-oval, apex obtuse; blackish; an elongate-oval spot on costa before middle, another larger from beyond middle to apex, and a dorsal streak, white; this leaves a broad median blackish streak from base of costa to tornus, prolonged along termen to apex, and broadly connected with mid-costa; cilia white with a small blackish apical hook. Hindwings lanceolate; pale grey; cilia $1\frac{1}{2}$, pale grey.

Queensland: Brisbane; one specimen.

Tinea leptocirrha, n. sp.

λεπτοκιρρος, slightly yellowish.

♂, 10 mm. Head ochreous-whitish. Palpi and antennae fuscous. Thorax fuscous. [Abdomen missing.] Legs fuscous; posterior pair grey. Forewings suboval, apex pointed; pale ochreous-grey, somewhat brassy; costa and dorsum with narrow bands of fuscous irroration; a transverse fascia formed by similar irroration connecting $\frac{2}{3}$ costa with tornus, narrow in disc, expanded on dorsum and costa; cilia pale grey with brassy reflections and a few fuscous points. Hindwings ovate-lanceolate; grey; cilia 1, grey.

Queensland: Coolangatta, in September; one specimen.

Tinea phaeochrysa, n. sp.

φαιοχρυσος, darkly golden.

♀, 17 mm. Head, thorax, palpi, and antennae brownish-ochreous. Abdomen pale grey. Legs brownish-ochreous; posterior pair whitish-ochreous. Forewings elongate-oval, apex obtuse; whitish-ochreous, densely strigulated with brownish-ochreous, smooth-scaled and lustrous, so as to appear dull golden; some tendency to the formation of wavy dark transverse lines, but no definite markings; cilia pale ochreous. Hindwings ovate; 5 and 6 stalked; pale grey; cilia $\frac{1}{2}$; pale grey.

Queensland: National Park (3,000 feet), in December; one specimen.

Tinea plagiomochla, n. sp.

πλαγιομοχλος, cross-barred.

♀, 15 mm. Head ochreous-yellow. Palpi fuscous. Antennae $\frac{4}{5}$; grey. Thorax and abdomen fuscous. Legs fuscous; posterior pair whitish-ochreous. Forewings strongly dilated posteriorly, apex rounded; ochreous-yellow; a short transverse bar in disc above tornus; termen narrowly fuscous; cilia fuscous. Hindwings ovate; ochreous-grey; cilia $\frac{2}{3}$, grey.

Queensland: Eidsvold; one specimen received from Dr. T. Bancroft.

Tinea sinapifera, n. sp.

sinapifer, partly yellowish.

♂, ♀, 14-16 mm. Head, thorax, and antennae fuscous. Palpi ochreous-whitish. Abdomen dark fuscous. Legs fuscous. Forewings with costa rather strongly arched, apex pointed, termen very obliquely rounded; purple-fuscous with blackish irroration in disc; a transversely elongate whitish discal spot at $\frac{3}{4}$; a short whitish line beneath costal edge shortly before apex; a whitish line from tornus towards but not reaching apex, close to termen, succeeded by some blackish scales; cilia fuscous with basal and subterminal whitish lines. Hindwings elongate-ovate; ochreous-yellow; a large apical fuscous blotch produced along dorsum; cilia fuscous.

Queensland: National Park (2,500-3,000 feet), in November; two specimens.

Tinea scythromorpha, n. sp.

σκυθρομορφος, of gloomy appearance.

♂, ♀, 12-14 mm. Head ochreous-whitish. Palpi 2, second joint expanded with rough scales towards apex and with an external series of short bristles; terminal joint stout at base; whitish, anterior surface of second joint sometimes fuscous. Antennae fuscous. Thorax and abdomen fuscous. Legs fuscous; coxae and femora whitish beneath. Forewings elongate-oval, costa moderately arched, apex round-pointed, termen very obliquely rounded; fuscous; cilia fuscous. Hindwings elongate-ovate; purple-fuscous; cilia fuscous.

Smaller than *T. amaurodes,* Low., from which it differs in the whitish head and very different palpi. In *amaurodes* the palpi are $1\frac{1}{4}$, very slender, almost filiform.

Queensland: Coolangatta, in September; National Park (3,000 feet), in November and December; five specimens.

Fam. COSSIDAE.

Zeuzera eumitra, n. sp.

εὔμιτρος, well banded.

♀, 52-56 mm. Head, thorax, and abdomen white. Antennae fuscous. Legs fuscous; anterior tibiae and tarsi with white annulations. Forewings elongate-oval, costa straight to middle, thence gently arched, apex round-pointed, termen rounded, oblique; white with blackish markings; seven quadrangular costal spots between base and middle; three transverse series of spots near base, first sub-basal, third at $\frac{1}{5}$, second slightly before third; three narrow, transversely elongate, dorsal spots between third line and middle; several small discal spots; a narrow transverse fascia from $\frac{2}{3}$ costa to $\frac{2}{3}$ dorsum, interrupted by fine white streaks on veins, slightly dilated between middle and dorsum; a double subterminal series of spots; three posterior costal spots, that one near apex larger; a terminal series, that one on tornus with a spot in disc shortly above it; cilia white with two or three small blackish bars. Hindwings with apex rounded, termen slightly rounded; white; a dark-fuscous spot, sometimes double, on dorsum near tornus, with a few variable dots on dorsum and before apex, which are not always developed. Underside similar.

This fine and distinct species is the second species of *Zeuzera* discovered in Australia.

Queensland: Brisbane, in February; two specimens from larvae boring the stems of *Eugenia ventenatii* (R. Illidge and H. Hacker); National Park (2,500

feet), in January; one freshly emerged found by lantern light running along a root crossing a scrub track; Toowoomba, in December; one specimen (W. B. Burnard).

Fam. HEPIALIDAE.

Porina beltista, n. sp.

βελτιστος, the best.

♂, 100 mm. Thorax fuscous-ochreous. Abdomen light red. Forewings triangular, costa straight to middle, thence sinuate, rather strongly arched before apex, apex pointed, termen straight, oblique, rounded beneath; fuscous-ochreous, slightly darker towards base; costa suffusedly fuscous to about $\frac{2}{3}$; a suffused, roundish, subdorsal, pale-fuscous spot at $\frac{1}{3}$; an oblique series of irregular, suffused, pale-fuscous spots between $\frac{2}{3}$ costa and mid-dorsum; a similar series, but with darker central transverse marks, subterminal; some scattered dark-fuscous dots posterior to this; some spots near termen similar to but paler than those of subterminal series; cilia concolourous. Hindwings with apex round-pointed, termen gently rounded; pale red, brighter red towards base, slightly ochreous tinged towards apex; cilia ochreous. Underside reddish-ochreous.

Queensland: Mount Nebo, near Brisbane, in May; one specimen with head mutilated and legs missing picked up on the road after mid-day, not quite dead, and in good condition otherwise. Probably it had been attacked by a bird or lizard. Further search resulted in the finding of one hindwing of a second moth. The finest species yet found of this genus, allied to *P. rufescens,* but with very different markings on forewings.

NATIVE MARKINGS ON ROCKS AT MOROWIE, SOUTH AUSTRALIA.

By Norman B. Tindale and C. P. Mountford.

[Read June 10, 1926.]

Plates XVII. and XVIII.

Recently one of us (C. P. M.) spent a fortnight in examining aboriginal camp-sites in the neighbourhood of Dawson, a township about sixteen miles north-east from Peterborough.

There are several sites in the vicinity, notably at Mount Grainger and Morowie Springs. At both places are numbers of small caves and rock shelters which were once occupied by the natives. The long extinct aborigines of the district were allied to the Adelaide tribe and spoke a dialect of the so-called Meyu language, common to the Adelaide and Yorke Peninsula peoples. Their dialect was briefly recorded by Messrs. Valentine[1] and Le Brun.[2]

At Morowie, where there are permanent springs, these caves and shelters are numerous (pl. xvii., fig. 1), and a level piece of ground near the water was used as a camping place. The prevailing rocks in the vicinity are (according to Mr. P. S. Hossfeld, to whom a specimen was submitted for determination) micaceous slate. The caves are often little more than holes in the rock, but some form commodious chambers; the walls of the latter are blackened with smoke, and the floors consist largely of fine slaty *débris* mixed with charcoal and animal bones. The floors of several caves were searched for buried implements, without success, but on the neighbouring camping grounds several well-formed hammer stones (of white quartzite and of fine sandstone), a quartz knife, and a flint gouge were picked up.

Rock Markings.

No definite signs of rock intaglios were noticed, although these are found both in the Flinders Ranges to the north and Mallett and Burra to the south. However, in a small cave, on an exposed face, and also rather high up on the walls of a rock shelter, numerous series of markings of a special character were examined.

These consist of narrow longitudinal grooves, from one to five centimetres in length, arranged in sets of small numbers, and cut more or less deeply into the slate with some stone implement.

An enlarged view (×2 approximately) of one group of these markings is shown in pl. xvii., fig. 4. The piece of rock bearing it was detached; rough plaster casts of other markings were obtained by means of wax moulds, and still other markings were recorded by making rubbings on translucent paper. Pl. xviii., fig. 1, shows some of the plaster casts and text fig. 1 a reproduction (×$\frac{1}{2}$) of some of the rubbings. A small quartz knife, shown in pl. xviii., fig. 1, was found on a neighbouring camp-site, and is capable of making similar grooves on the slate.

All the markings at Morowie are strongly patinated and stained with iron oxide, which is believed to be an indication of age; those on exposed surfaces have been partially destroyed by weathering and lichen growths. A few of the

(1) Valentine, C., in Curr, "Australian Race," v. ii., 1886, pp. 138, 139.

(2) Le Brun, S., *l.c.*, ii., pp. 140, 141.

more accessible examples, shown in pl. xvii., fig. 3. were touched up with chalk for purposes of photography.

The cave shown in pl. xvii., figs. 2 and 3, is not more than 4 feet high, 2 feet wide, and 5 feet deep (the scale shown in the figure is 6 inches long). The markings occur not only on the walls near the opening but also on the inside. A convenient rounded and projecting ledge, running obliquely along one wall, bears numbers of the incisions; indeed, they are so closely crowded as rather to obscure the grouping elsewhere evident. These markings appear not to have been made at one time, but on many different occasions. The commencement of this ledge is shown at the lower right corner of pl. xvii., fig. 3, and other less accessible portions are reproduced in the two larger casts shown in pl. xviii., fig. 1.

As previously mentioned, the markings occur in groups, always of small numbers, although this arrangement may be regarded as obscure on the ledge

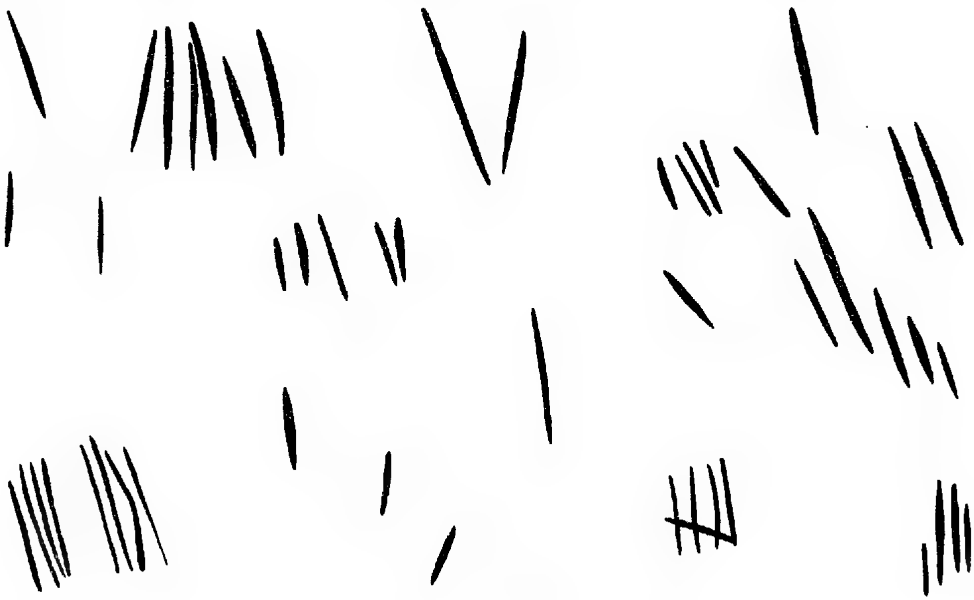

Fig. 1. Morowie rock markings (×½).

referred to. In text fig. 1 all the markings from several portions of rock are included, each group as far as possible in its relative positions. Single cuts, often short and deep, occur very frequently, pairs only sparingly. Sets of three, four, and five are also present. In several cases two sets are in association, and the group of four shown in pl. xvii., fig. 4, bears an additional mark, cutting the vertical ones at an angle; this was evidently scratched last. The presence of fine lines over the intervals between the deep grooves in this example points to the use of a very fine-edged tool and the employment of numerous strokes in the making of some incisions.

Motive of Morowie Markings.

Several views may be held as to the origin and significance of the marks. Their native origin cannot easily be denied. It may be claimed that they are idle marks produced by some native without better employment. This is discounted by their great numbers, their occurrence in several places, and their

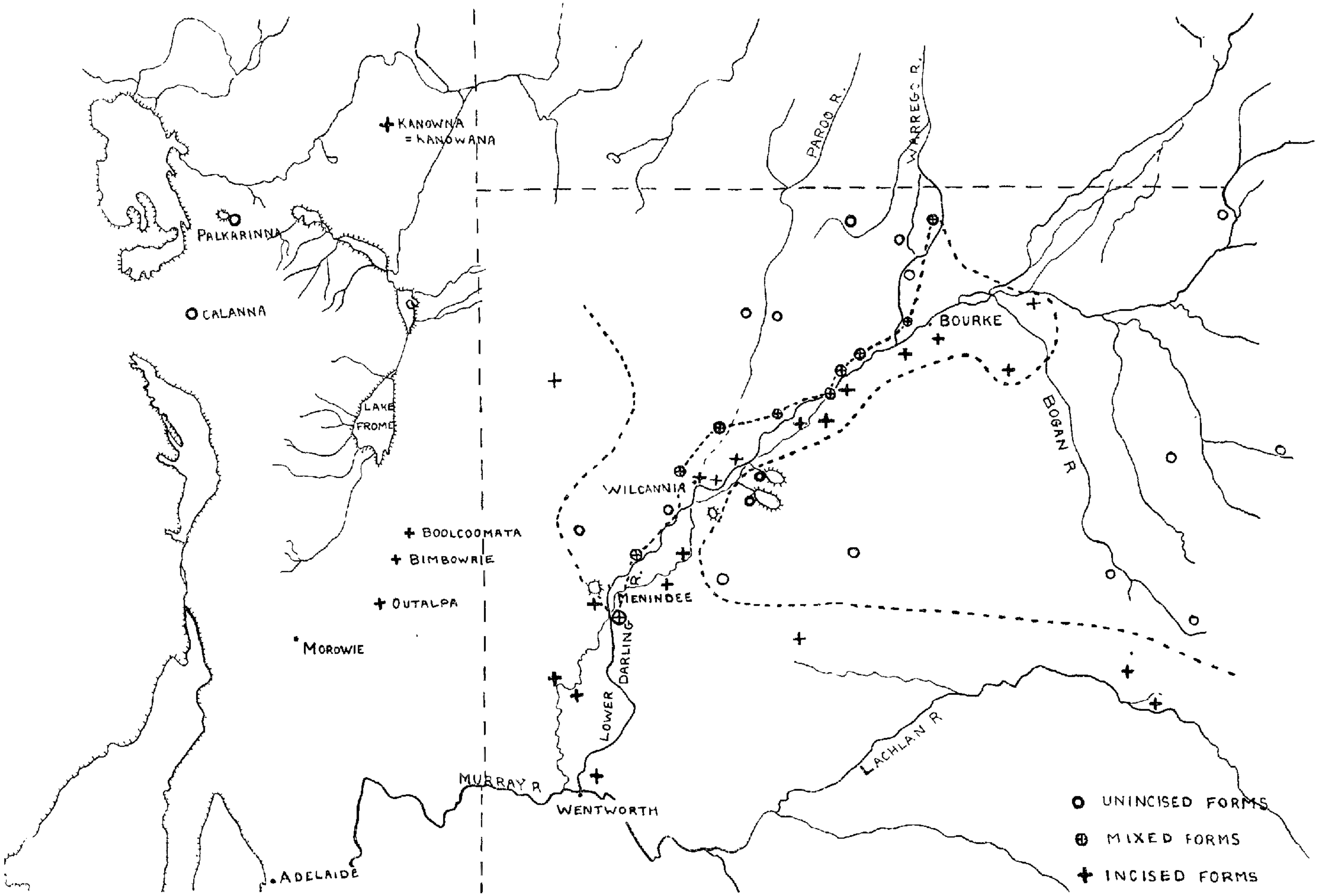

Fig. 2. Map of Lower Darling River and part of South Australia, showing distribution of incised and other cylindro conical stone objects.

Fig. 1. Scene at Morowie Springs.

Fig. 2. Cave with markings on wall.

Fig. 3. Close view of entrance, showing some markings.

Fig. 4. Morowie rock markings (×2).

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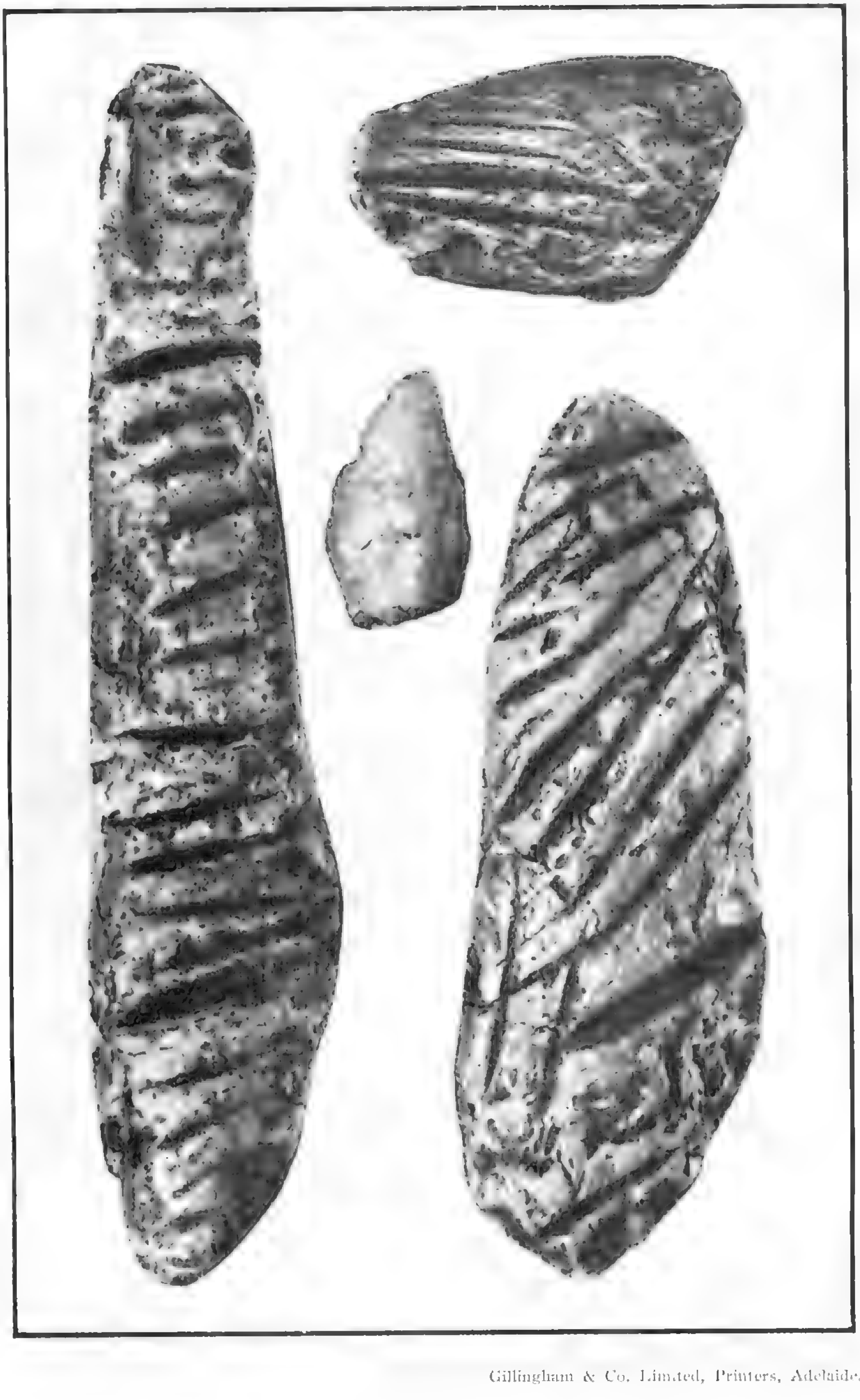

Fig. 1. Morowie rock markings (casts) and quartz knife.

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grouping. It is possible that they are the result of the sharpening of delicate stone tools. There are a few objections to such a view, one is their presence in some places awkward of access to one desirous of giving a fine edge to a tool, and another the comparative softness of the slate.

The superficial resemblance of the incisions to the "tally marks" found on many of the so-called "cylindro-conical and cornute stones" is, perhaps, worthy of notice.

"Tally Marks" on Cylindro-conical Stones.

In the Darling River district of New South Wales, and the north-eastern part of our State, several hundred of these stones have been found and deposited in collections. Etheridge[3] has summarized all the early records, and Pulleine[4] has supplied recent references.

The localities and data of about 130 examples are available in literature, and from a study of these records it appears that, contrary to Etheridge's opinion, the incised and unincised stones (which occur in about equal numbers) each have a definite distribution over the above-mentioned areas. An examination of the map (text fig. 2) shows that incised forms are prevalent over the south and south-western areas, that is, in part of South Australia, and along the courses of the Lachlan River, and of the Lower Darling in New South Wales. The non-incised forms are equally widely distributed in the north and north-eastern areas. The occurrences along the course of the Darling River, between Menindee and Bourke (from whence more than half the known examples have been obtained, and where in some places both forms are found in association), also indicate a definite distribution.

The incisions on the cylindro-conical stones from the south-western areas are often arranged in sets of small numbers scattered over the body of each stone. Such "record" stones have, for example, been noted from Popilta, near Wentworth, and from Bimbowrie, Outalpa, and Boolcoomata in South Australia.

If we adopt the view, suggested many years ago and recently brought into prominence by Pulleine[5] and others, that these markings (whatever be the further significance of the stones) are actual "tally marks" recording events or objects, we may perhaps not unreasonably suggest that the Morowie markings represent non-portable records of a similar character. In this connection it is of interest to note that Freeman[6] describes an example of a cylindro-conical stone said to bear the "record of burials of 49 adults and 12 children."

DESCRIPTION OF PLATES XVII. and XVIII.

Plate XVII.

Fig. 1. Scene at Morowie Springs.
,, 2. Cave with markings on wall.
,, 3. Close view of entrance, showing some markings.
,, 4. Morowie rock markings (×2).

Plate XVIII.

Fig. 1. Morowie rock markings (casts) and quartz knife.

(3) Etheridge, R., jun., Mem. Geol. Surv. N.S. Wales, Ethnol. Ser., No. 2, 1916, pp. 1-42, pls. i.-ix.

(4) Pulleine, R., Trans. Roy. Soc. S. Austr., 1922, 304-307.

(5) Pulleine, R., *l.c.*, p. 306.

(6) Freeman, W., Rep. Austr. Assoc. Adv. Sci., 1902 (1903), ix., p. 539.

VARVE SHALES ASSOCIATED WITH THE PERMO-CARBONIFEROUS GLACIAL STRATA OF SOUTH AUSTRALIA.

By D. Mawson, Kt., D.Sc., F.R.S.

[Read July 8, 1926.]

A notable feature of the stratified deposits of glacial regions is the regular lamination of the finer fluvio-glacial beds, due to recurrent annual contributions resulting from summer thaw and winter refrigeration. This remarkable characteristic, which was emphasised and of which the significance was indicated in the case of the Tapley Hill and other local slates in a paper (1) contributed as long ago as the year 1907, is now widely known under the term "varve" structure.

Further reference to the subject and to the occurrence of varve beds in the Permo-Carboniferous strata of this State was made by me at the last meeting of the Australasian Association for the Advancement of Science. As my paper was accidentally omitted from the volume of the Proceedings, these notes are now contributed as a record of the occurrence in strata of the later period. Observations on the Proterozoic varve formations are to appear elsewhere.

The Permo-Carboniferous fluvio-glacial deposits of this State are, for the most part, constituted of a sandy nature. Finer-grained silts are little represented; at least this is so in the case of almost all the outcrops. Such conditions are not favourable for the development of varve structures. However, even the thick sandy beds do, in some areas (2), exhibit traces of lamination and contemporaneous contortion.

Fluvio-glacial depositions in ponded waters are but rarely met with in our Permo-Carboniferous strata and marine depositions of this age are entirely absent. The localities that have come under notice where such clayey sediments occur are very local in extent and represent lakelets in the then glacial valleys, either as over-deepened, rock-bound basins or produced by moraine dams or ice blockages.

OCCURRENCE NEAR MOUNT MAGNIFICENT.

The most illustrative case examined is situated at the southern edge of Section 292, Hundred of Kuitpo. This is on Blackfellow's Creek, at its junction with the Finnis River, and just below Mount Magnificent. At this place a Permo-Carboniferous glacier had over-deepened its bed, burrowing over many acres in extent a deep basin in a Pre-Cambrian terrain. The latter consists of highly altered sediments with semi-acid igneous intrusions.

Upon recession of the ice this rock basin was evidently occupied by a small lake and became gradually silted up with fluvio-glacial sediments. These are now presented as hard, consolidated beds of shale and sandstone. The dominant feature is a straw-coloured pelitic formation of a porcellaneous nature which exhibits varve banding.

Strata of a few inches to a foot or more in thickness composed of this porcellaneous laminated rock alternate with less conspicuous thinner bands of a distinctly more sandy nature. This coarse structure may represent the seasonal variation between summer and winter deposition, the finer laminations corresponding to the contributions of a sequence of individual thaws during that major cycle. The alternative explanation is that all pairs of laminae refer each to the sediments of a single year. The exposures are not sufficiently perfect or extensive to decide this point.

In order to illustrate the nature of the minor laminations actual measurements are herewith given relating to a specimen collected from a pelitic stratum. The figures mentioned refer to the thickness of individual laminae:—

		Coarse psammite stratum.
2·2	inches,	very fine-grained pelite. In the upper 1·4 inches of this layer 15 very faint laminae are traceable.
0·17	,,	psammitic pelite.
0·70	,,	pelite.
0·10	,,	a faint band of somewhat psammitic pelite.
0·70	,,	pelite.
0·15	,,	a faint band of somewhat psammitic pelite.
0·15	,,	pelite.
0·10	,,	psammitic pelite.
0·30	,,	pelite.
0·20	,,	psammitic pelite.
0·30	,,	pelite.
0·10	,,	coarse psammite.

In the field the exposure is limited on account of extensive recent alluvium now mantling the surface of the valley. No useful estimate of the thickness of the varve beds can be gleaned, for they are visible only for some 10 feet vertically in the bank of the creek. It is not likely that they extend to a greater depth than, say, 50 feet below the visible base.

As exposed on the north bank of Blackfellow's Creek they contain, in the coarser strata, occasional well soled and faintly glaciated sandstone erratics up to several inches in length. The beds are not far from horizontal, dipping only a few degrees to the north-west. The topmost shales are bleached pure white owing to the leaching action of surface waters.

OCCURRENCE NEAR NORMANVILLE.

About half a mile east-north-east of Heycock Point, near Normanville, varve clays are exposed in washouts in the gullies. There is in that vicinity a Permo-Carboniferous valley depression cutting through a belt of Cambrian Archaeocyathinae limestone, and open to the coast on the west. It has been choked with glacial and fluvio-glacial sediments, but is now largely re-excavated. When the ice withdrew from this rock-walled valley it appears to have been dammed up lower down (to the west) either by morainic *débris* or by an ice face. In this area thus ponded, alternating sandy and clayey layers were laid down, exhibiting fine lamination.

As exposed, the lower beds are light-coloured clays with obvious sandy laminae; occasional small erratics appear embedded therein. Somewhat higher up in the series several cases of local contortion were noted. For example, in a belt of 6 inches in thickness, the laminae have been remarkably puckered whilst above and below the clays lie flat and regular. In one puckered horizon a granite erratic 18 inches in length is embedded. This latter is an exception, however, for erratics are rare in the well laminated beds.

Still higher up in the series the clays become more yellow in colour and finally brick-red. At the top of the section, the clays are displaced by sandy strata from which a considerable number of striated erratics weather out and are strewn on the surface.

In this valley depression, the glacial and fluvio-glacial sediments extend from about sea level to an elevation of some 300 feet or more. A minimum thickness of the fluvio-glacial beds is estimated at 100 feet.

As regards the thickness of the laminae in these clays, it varies through wide limits. The thinnest lamination observed gave an average measurement of 0·03 inch when measured over a thickness of several inches. The more general fine banding averages 0·06 inch thick for each individual lamina, whilst 0·12 inch in thickness is quite common. In the upper beds the banding is coarser and single bands an inch in thickness are not rare.

HALLETT'S COVE.

The third locality to which reference is here made is Hallett's Cove. Laminated sandy and clay beds are exposed in washouts in the amphitheatre at the north end, and coarsely banded fluvio-glacial beds also appear resting on the polished pavement above Black Point. The more typical are the chocolate to salmon-coloured claystones and associated sandy bands forming the lower beds in the amphitheatre. This glacial basin was excavated to a depth that is now considerably below sea level, and upon recession of the ice remained a ponded area for some time at least, allowing fluvio-glacial depositions to accumulate therein. The total thickness of the formation certainly exceeds 50 feet, but as it extends below sea level its downward extension is only conjecture.

The major structure exhibited is that of a coarse and rather irregular alternation of pelitic and psammitic beds, such as a sandy band of, say, 3 inches in thickness, followed by a claystone stratum 8 inches thick. Superimposed on this more obvious feature is a fine lamination generally well shown in the somewhat sandy strata and less evident or absent in pure claystone. Where it was well shown measurement showed an average of six sandy partings to the inch, or about 0·16 inch as the thickness of each pair of coarse and fine laminae.

CONCLUSION.

In conclusion, it is to be remarked that the occurrence of varve sediments in the local fluvio-glacial beds of Permo-Carboniferous age is further evidence in accordance with the general thesis advanced by myself some twenty years ago, namely, that lamination is to be expected in both interglacial sediments and in those deposited in regions bordering glaciated areas. In fact, fine lamination in fluvial sediments, though not certainly indicative of glacial conditions, is certainly corroborative evidence when taken in conjunction with other criteria.

The original paper (1) submitted was particularly concerned in deducing evidence to show that the Tapley's Hill slates and other laminated beds of the Adelaide Series were as surely sediments of a glacial epoch as the Sturtian Tillite itself, the only difference suggested being that of the severity of glaciation.

In the north-east of this State and in the Barrier Ranges I have mapped beautifully laminated slates (practically indistinguishable from the Tapley's Hill slates themselves) of older age than the Sturtian Tillite horizon, which latter overlies them unconformably with a big erosion interval between. Boulders of this older varve-like slate actually appear as erratics in the Sturtian horizon of that area. This, in my opinion, is strong indication of glacial conditions in the neighbourhood in earlier Pre-Cambrian times. As geological mapping of the State progresses it may happen that actual tillite may somewhere be located at this horizon.

REFERENCES.

1. "The Association of Laminated Clays, Shales, and Slates with Glacial Deposits; their Significance and Chronological Value," by D. Mawson, B.E., B.Sc. Read before the Austr. Assoc. Ad. Sc., January, 1907.
2. "Description of a New and Extensive Area of Permo-Carboniferous Glacial Deposits in South Australia," by W. Howchin. Trans. Roy. Soc. S. Austr., vol. xxiv., p. 231.

A REVISION OF THE "SWEET" COLLECTION OF TRIASSIC PLANT REMAINS FROM LEIGH'S CREEK, SOUTH AUSTRALIA.

By Fredk. Chapman, A.L.S. (National Museum, Melbourne), and
Isabel C. Cookson, B.Sc. (Melbourne University).

[Read July 8, 1926.]

Plates XIX. to XXIV.

INTRODUCTION.

As some question has arisen of late regarding the exact age of the Leigh's Creek fossiliferous coal shales, it was thought an opportune time to examine in detail the original specimens in the "Sweet" Collection determined in 1895 by Mr. Robert Etheridge, jun.[1]

Since, as far as we know, very little additional material is being collected from this area, and that all the previously known specimens are in the "Sweet" Collection, which has been generously presented to the National Museum, Melbourne, by Dr. Georgina Sweet, it has been urged by Mr. L. Keith Ward, B.A., B.E., Government Geologist of South Australia, that we carry on this work.

In consideration of Mr. Etheridge's careful examination and description of the "Sweet" Collection, it might almost seem invidious to thus revise the collection; but in view of the fact that since then so much light has been thrown on this subject from the examination of the Mesozoic flora of the other States, especially from Queensland, by the work of Dr. Walkom,[2] it is hoped that the present effort may justify itself.

DESCRIPTION OF THE PLANT REMAINS.

Series *PTERIDOPHYTA*.

Class *EQUISETALES*.

Fam. EQUISETACEAE.

Genus Equisetites, Sternberg, 1833.

Equisetites rotiferum, Tenison-Woods.

Pl. xix., fig. 1

Equisetites rotiferum, Tenison-Woods, 1882, p. 344; *Idem*, 1883; *Ibid*, p. 66, pl. vi., figs. 5, 6 Walkom, 1915, p. 27, pl. i., figs. 2, 3; pl. ii., fig. 4.

Description.—The present example is a stem which carries three nodes with two complete internodes. The total length is 4·5 cm., and the width at the nodes 5·5 mm.; the median diameter of the internodes is slightly less, being about 5·1 mm. The stem is distinctly striated, showing six or seven longitudinal flattened ridges. The nodes are clearly shown and the concave bases of the leaf sheath are very distinct.

By examining the fossil in a favourable light the leaves are seen to be carinate, with the teeth sharply denticulate, but short and broad, at the base, the height of the leaf sheath being only 1·25 mm.

(1) Etheridge, R., jun., 1895, pp. 138-145, pls. iv.-vi.

(2) Walkom, A. B., 1915-1919.

Observations.—This genus was recorded by Etheridge, jun., from Leigh's Creek, but he regarded the specimens he examined as undeterminable. Since the specimens before us do not tally in measurement with those given by him, it is doubtful whether he examined the present example.

As regards the original description of this species by Tenison-Woods, the only difference we observe is the slightly more numerous teeth, his type showing 9 free teeth as against our 7; but this might easily be accounted for by variations in different parts of the same plant.

Walkom has dealt with the species in his Queensland paper, referred to above, and one specimen figured by him, from Nundah Colliery, Ipswich Series, which determination he queries in the explanation of plate, is most like the present specimen. In reference to the Nundah Colliery specimens, Walkom remarks, in regard to the axis, that "while these are not sufficiently good specimens to separate from *E. rotiferum* as a distinct species, it must be noted that they show a close resemblance to figures of *E. gracilis* (Nathorst) from the Rhaetic rocks in Sweden given by Halle.[3] These few specimens from Nundah and those from Tivoli Mine are the only ones similar to *E. rotiferum* which have been obtained from the Ipswich Series, the lowest division of the Trias-Jura rocks."

Distribution.—Ipswich Series (Trias): Tivoli Mine and Nundah Colliery, Queensland. Walloon Series (Jurassic): Walloon Mine (type locality) and Wallumbilla, Queensland.

(?) EQUISETITES sp. Stem with strobils.

Pl. xix., fig. 2.

Description.—This stem is preserved in an ochreous and porcellanised shale. It has a length of 10·2 cm. and a diameter of 2·15 cm. There are three faint nodal impressions in the length of the stem, which suggest *Equisetites.* Leaf remains are practically absent, a few vestiges of doubtful character alone suggesting their presence. In one or two cases these appear to be aciculate and closely adpressed to the stem.

Several cone-like bodies, of which one is well preserved, occur on the stem. The latter is sessile, the point of attachment being slightly above the nodal area. It is ovate in form, broader at the apex. Its surface is divided into large subangular areolae of unequal size, whilst there appears to be an outer investing cup-like layer, the surface of which is distinctly wrinkled.

In the occurrence of laterally disposed strobils, comparison might be made with *Equisetites Hemingwayi* of Kidston,[4] in which short, ovoid strobils are found sessile at the nodes of the stem. A point of comparison worth noting is that in Kidston's species the surface of the strobil is polygonally marked very much as in the present specimen, although the general outline is not the same.

Another comparison is with a strobilus figured by one of us,[5] which occurs laterally on the stem of *Phyllotheca australis;* the chief distinction is that the apex of the cone is flattened in the latter, instead of being obtusely pointed, and further, there is no indication in our specimen of the typical *Phyllotheca* leaf arrangement.

On the whole, the affinities of this curious specimen remain obscure, and it will be possible to assign it to its correct systematic position only when more and better preserved material is available.

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(3) Halle, T. G., 1908, p. 15, pl. iii., figs. 12-18.

(4) Seward, A. C., 1898, p. 262, fig. 57.

(5) Chapman, F., 1904, p. 314, pl. xxviii., fig. 7.

Genus NEOCALAMITES, Halle, 1908.

NEOCALAMITES HOERENSIS, Hisinger sp.

Pl. xix., figs. 3-5.

Calamites hoerensis, Hisinger, 1836-40, p. 5, pl. xxxviii., fig. 8.

Schizoneura hoerensis, (Hisinger) Schimper, 1869, p. 283.

Neocalamites hoerensis, Schimper sp., Halle, 1908, p. 6, pls. i. and ii. Walkom, 1915, p. 33, pl. ii., fig. 1; *Idem*, 1924, p. 79, pl. xv., fig. 1.

Description based on three examples.—At least three specimens in the present collection seemed referable to the above species. In their general measurements they agree with those given by Schimper for this species. The best preserved of our examples *(a)* is a stem having a length of nearly 7 cm. and a width from 1·1 to 1·5 cm. This specimen has four joints with well-marked nodes; the general surface of the stem appears to be an impression of the inner portion, but there are carbonised areas *(c)* which represent the outer surface. The stem is finely striated; this shows to best advantage in specimen *(c)*, where the carbonised cortex is well preserved.

In this and the other specimens the cicatrices of the individual leaves are distinctly seen; in one of the stem fragments *(b)* the node bears 8 or 9 distinct leaf scars which have a width of about 1·5 mm. The outer rim is a slightly raised circular ridge, within which is a depressed area, sometimes showing a central papilla.

There are two instances where impressions can be observed on the internodal portions of the stem of larger scars than those on the node, which may be displaced nodal diaphragms.

The remains of leaves are rare, but there are one or two examples which show close affinity with those of the type, both in the size and form of the leaf and in the fact that the leaves are free along their whole length. One of these incomplete leaves has a length of 34 mm. and a width at the base of 2 mm. The width of the leaves is not constant, but varies along the length of the leaf from 2·5 mm. to 1·5 mm. The midrib is a noticeable feature, and there are, in addition, less pronounced parallel striae.

Comparisons.—In Schimper's original description the diameter of the stem is cited as from 3-6 mm.; in the present form it measures only 11 mm., but since Halle has described an associated series in which the stem measurements vary more greatly than the original description, and which seem to belong to one species, we consider our specimens may reasonably be included under that form.

Walkom has also recorded this species from the Ipswich Series of Queensland, and his specimen, which he figures, has even a less diameter than ours, and practically half.

At first we were inclined to consider the claims of *N. meriani*, Brongniart sp., but in that form the leaves appear to be generally wide.

Distribution.—Ipswich Series: Queensland. Rhaetic: Sweden.

Fam. SCHIZONEUREAE.

Genus SCHIZONEURA, Schimper and Mugeot, 1844.

SCHIZONEURA sp.

Pl. xix., fig. 6; pl. xx., fig. 7.

Schizoneura sp., *a*, Seward, 1908, p. 86, pl. iii., figs. 1, 2. Walkom, 1915, p. 36, pl. iv., fig. 1; *Idem*, 1924, p. 80, pl. xvi.

Description.—One of the stems which we refer to *Schizoneura* sp. has a length of 10 cm. and a width of 3 cm. In this specimen there are two nodes, a complete internode and portion of two others. The nodal area is defined by a ridge-like prominence, irregularly nodulose, and at one portion of the node, at

one extremity, there appears to be a lanceolate, leaf-like structure, lying upon the surface of the stem and its base adjoining the node. There is, however, no spreading of the lamina as is usual in *Schizoneura* leaves.

The fossil is evidently a compressed stem with a carbonised layer representing the outer surface, and this seems to be borne out by the fact that the striations are very much finer than those in Seward's South African specimen and also in Walkom's example from Esk, Queensland. The striations amount to as many as 22 in 5 mm. as against those of the pith-cast in the latter specimen, where there are 8 to 10. This specimen was one of those examined by Etheridge, jun., and which he referred to in the 1895 paper as *Equisetum* sp.

Two other specimens are found in this series, both of which measure 4·2 cm. in diameter, and in which the node is very distinctly shown, together with depressed circular scars. These number about 14 in the diameter, and have much the same appearance as some figured by Feistmantel as *S. gondwanensis.*

The stems now under consideration compare closely in character with that described by Walkom, in 1915, as *Schizoneura* sp. from the Ipswich Series, in which the stem measures 4·5 cm., but the internodes are slightly larger.

Distribution.—Burghersdorp Beds of the Middle Karroo or Beaufort Series: South Africa; Trias. Ipswich Series: Queensland; Trias. Walloon Series: Queensland; Jurassic.

Class *FILICALES.*

Fam. (?) OSMUNDACEAE.

Genus Cladophlebis, Brongniart, 1849.

Cladophlebis Albertsi, Dunker sp.

Pl. xx., fig. 8.

Neuropteris Albertsi, Dunker, 1846, p. 8, pl. vii., figs. 6, 6*a*.
Alethopteris Albertsi, Dunker sp., Schenk, 1871, p. 218, pl. xxvii., fig. 4.
Cladophlebis Albertsi, Dunker sp., Seward, 1894, p. 91, pl. viii.
Alethopteris sp. indet., Etheridge, jun., 1895, p. 143, pl. iv., figs. 1, 2.

Observations.—Seward's [6] extension and modification of the original diagnosis runs as follows:—"Frond bipinnate, rachis flat and broad, pinnae linear lanceolate, alternate to opposite, pinnules falcate, contiguous, attached by whole of broad base, acuminate, margin entire or slightly dentate towards the apex."

Etheridge, jun., in his remarks on one of the specimens now examined, discusses the affinities of this species, and remarks that "The nearest allies appear to be *A. australis,* Morris; *A. Rosserti,* Presl.; and *A. Albertsi,* Schimper." As regards *A. Albertsi,* Etheridge observes that "the pinnules are of the same semi-falcate outline, and the secondary veins are once furcate, but collectively the pinnules do not present the same degree of regularity."

On a re-examination of the specimens figured by Etheridge, jun., we notice that in fig. 2 the drawing does not quite closely follow the specimen, for the pinnules distinctly broaden towards the base, becoming semi-falcate in character.

The fronds which Newell Arber [7] has figured, from the Neocomian beds of the Waikato Heads, Auckland, and described as *Cladophlebis* cf. *Albertsi,* Dunker sp., show marked resemblance to the above specimens.

Since Etheridge, jun., has already so well described the specimen we now re-figure, we append his notes [8]:—"The pinnules are short, subfalcate, curved,

(6) Seward, A. C., 1894, p. 92.
(7) Newell Arber, E. A., 1917, p. 28, pl. iv., figs. 2, 3.
(8) Etheridge, R., jun., 1895, p. 143.

upwardly directed, and touching; the margins are entire towards the apex, and the latter obtuse. The midrib in each pinnule is continuous almost to the apex, where it slightly evanesces, the secondary veins are from eight to twelve in each pinnule, and once furcate."

Distribution.—Wealden: Germany. Neocomian: New Zealand. Lower Cretaceous: Maryland, U.S.A.

In connection with the present occurrence of *C. Albertsi* in Australia, it is of interest to note that Seward [9] mentions that "A specimen in the British Museum (41417) from the Douglas River Coal Seam in Tasmania is probably identical with the Wealden Species of *Cladophlebis.*" This occurrence is all the more interesting since it points to the quite early appearance of the species in the Mesozoic elsewhere in Australia, the Tasmanian beds being of Trias.-Jura. age.

Fam. THINNFELDIAE.

Genus THINNFELDIA, Ettingshausen, 1852.

THINNFELDIA FEISTMANTELI, Johnston.

Pl. xx., fig. 9; pl. xxi., fig. 10.

Thinnfeldia Feistmanteli, Johnston, 1896, figs. 2, 16.

Dicroïdium Feistmanteli, Johnston sp., Gothan, 1912, p. 78, pl. xvi., fig. 1. Antevs., 1913, p. 3, pl. i., figs. 1-7.

Thinnfeldia Feistmanteli, Johnston, Walkom, 1917, p. 17, pl. i., fig. 3; pl. ii., figs. 1, 2; text fig. 5; *Idem*, 1924, p. 81, pl. xvii., fig. 1F.

Observations.—Well-preserved examples of the above species are represented in some abundance in the "Sweet" Collection. They are usually preserved in a porcellaneous shale, when the venation is beautifully shown; others occur in a dark foliated and carbonaceous shale. From the large pieces of frond preserved it is clearly seen that the form here represented belongs to the species *T. Feistmanteli,* on account of the bipinnate nature of the frond.

This species has not been recorded by Etheridge, jun., from the Leigh's Creek Series, but he mentions the occurrence of "a few pinnules, oval to subreniform in outline," which he refers to the species *T. odontopteroides,* Morris sp. Mr. Etheridge, jun., has also previously recorded *T. odontopteroides* from Leigh's Creek [10] in referring to a collection obtained through the South Australian Geological Survey, and remarks that "The Leigh's Creek bore at present in progress has yielded several species of this characteristic Australian Lower Mesozoic plant"; and adds, "The specimens exposed on the fractured surface of the bore core are that variety of *T. odontopteroides* with strictly rhomboidal pinnules and close-set, or, in fact, almost semi-imbricating, but not as large as the largest usually found in Eastern Australia, although equal in size to some there met with." He further says it is even possible that "they may fall into the variety *obtusifolia,* Johnston."

The principal rachis has an average width of 7 mm. and its surface is distinctly rugose. This character has been noted by Walkom in Queensland forms, and he suggests a close resemblance to the transverse markings shown by *Sphenopteris elegans (Heterangium Grievi),* which are the result of numerous horizontal plates of thick-walled cells in the cortical tissue.

From the main rachis arise the secondary branches which bear the pinnules, and these secondary rachae at 6 mm. from the principal rachis measure 2·5 mm. in width. The pinnules seem to be uniformly of the obtuse-lobate type, almost cordate, and attached by the whole base to the secondary rachis. The veins are clearly seen to be the odontopteroid type, each starting from a common base and dividing once, or even twice, before reaching the margin. Some of these forms

(9) Seward, A. C., 1894, p. 94.

(10) Etheridge, R., jun., 1891, p. 10.

when complete must have been of quite handsome dimensions, about 17 pinnules being counted in one pinnate series alone, while from one of the largest specimens we conclude that the width of the frond measured in its complete state as much as 22 cm.

The actual method of growth can only be seen in the larger specimens, for the terminal portions differ in a marked degree from the basal by their more open growth and the less irregular rhomboidal form of the pinnules (pl. xx., fig. 10).

The present examination results in our noticing the complete absence of *T. odontopteroides*, and we are inclined to think, in the face of the difficulty of naming fragments, that "the oval to subreniform pinnules" referred to *T. odontopteroides* by Etheridge, jun., may very easily be regarded as fragments of *T. Feistmanteli*, for the distinction between the two species seems to be based almost entirely on the pinnate character of the former and the bipinnate form of the latter. We also agree with Walkom, who has placed these specimens in the synonomy of *T. Feistmanteli.*

Distribution.—(?) Rhaetic: New Zealand (Owaka Creek). Trias.-Jurassic: Tasmania. Ipswich Series: Queensland. Walloon Series: Queensland. Middle Jurassic: New Zealand (Cuno Bay, Waikawa).

THINNFELDIA LANCIFOLIA, Morris sp.

Pl. xxi., fig. 11

Pecopteris odontopteroides, var. *lancifolia*, Morris, 1845, pl. vi., fig. 4.

Thinnfeldia lancifolia, Morris sp., Arber, 1913, p. 346, pl. viii., fig. 7. Walkom, 1917, p. 21, pl. iii., fig. 3; pl. iv., fig. 1; pl. vii., fig. 2; text fig. 6. Arber, 1917, p. 49, pl. v., figs. 1, 2, ? 6. Walkom, 1924, p. 82, pl. xv., fig. 3.

Observations.—There is here one example of a *Thinnfeldia* with elongate and acutely placed pinnules, which we refer to the above species. The specimen is preserved in a reddish shale, probably burnt, and shows sufficient characters to indicate its relationship to *T. lancifolia.*

Distribution.—*T. lancifolia* occurs in both the Ipswich and Walloon Series in Queensland.

FERN-LIKE PLANTS. Incertae sedis.

Genus TAENIOPTERIS, Brongniart, 1828.

TAENIOPTERIS DUNSTANI, Walkom.

Pl. xxi., fig. 12.

Taeniopteris sp. indet., Etheridge, R., jun., 1895, p. 140, pl. iv., fig. 1.

T. Dunstani, Walkom, 1917, p. 37, pl. ix., fig. 1.

Description.—The frond is narrow-lanceolate (?), 5 mm. wide at the base, gradually expanding until a maximum width of 1·8 cm. is reached; its length is 11 cm. The distal end of the leaf is, unfortunately, missing, so that the type of apex, as well as its total length, is unknown. The midrib is very prominent, having a width of 2·5 mm.; it is longitudinally striate, and judging by its size at the broken end of the specimen, it would appear highly probable that it persisted to the apex of the leaf.

The secondary veins arise from the midrib at an angle of about 70° and are mainly simple, 15 occurring in the space of 1 cm. Occasionally two adjacent veins join, a feature exhibited by the type and regarded by Walkom as a constant feature in the species. The margin of the leaf is well defined, but a distinct marginal vein, however, is not very evident.

This leaf, on the whole, agrees well with Walkom's description; it is not so distinctly lanceolate as in *T. lentriculiforme*, Eth. *fil.* sp., and there seems little doubt that the form is identical with the Queensland plant.

Distribution.—Ipswich Series: Queensland.

TAENIOPTERIS cf. TENISON-WOODSI, Etheridge *fil.* sp.

Pl. xxi., fig. 13.

Angiopteridium ensis, Tenison-Woods (non Oldham and Morris, 1863), 1883, p. 119.
Angiopteridium Tenison-Woodsi, Etheridge, R., jun., 1892, p. 375.
Taeniopteris Tenison-Woodsi, Eth. *fil.*, Walkom, 1917, p. 32, text fig. 9; Idem, 1924, p. 86.

Description.—One small, imperfectly preserved leaf is tentatively referred to this species. It is only 2·5 cm. long, narrowly lingulate, with a maximum of 6 mm. The midrib is clearly defined, traversing the entire length of the leaf, but the secondary veins are very indistinct. There are, however, one or two instances of obliquely arising veins visible, which suggest a possible affinity with this species.

Distribution.—Ipswich Series: Queensland. Walloon Series: Queensland.

TAENIOPTERIS FLUCTUANS, Etheridge *fil.*

Pl. xxii., figs. 14, 15.

Taeniopteris (Oleandridium ?) fluctuans, Etheridge, jun., 1895, p. 139, pl. v., figs. 1-3. Howchin, 1918, pp. 431, 432, figs. 1-3.

Description of Holotype (now in National Museum, Melbourne) by R. Etheridge, jun.:—"Frond simple (as far as known), elongately lanceolate, thick, coriaceous, crumpled, lateral margin sinuous. Midrib thick, moderately wide, and possibly longitudinally striate, secondary veins fine, straight, two in the space of 1·5 mm. passing from the midrib at a right angle, sparsely furcate, and when so generally on leaving the midrib, very rarely in the middle of wing."

On re-examining the type specimen we find one or two points of minor importance which may well be included with the original description, and which in some way modify it. Thus, the midrib, which measures 2·5 mm. in width in the main portion of the leaf and about 3 mm. at the base, is strongly vertically striated, and in one of the places having one of the striations, generally median in position, more dominant. The secondary veins are only once divided and the bifurcation is usually close to the midrib, but occasionally the forking takes place near the margin as well as in the median area.

This form is closely related both to *T. Carruthersi*, Tenison-Woods, and *T. vittata*, Brongn. sp. It differs, however, from the former in the single bifurcation of the secondary veins and in the flexured lamina, and from the latter in the single bifurcation (where, according to Feistmantel, they branch more than once), as well as in the shorter petiole and more parallel-sided lamina. In a fragment of ironstone in this collection there is an impression of the petiolate end of a frond, in which one side of the lamina is preserved, showing the rather widely spaced and basally forked veins. The edge of the leaf is undulate and almost crenate. There is no doubt on these characters that it is identical with *T. fluctuans.*

TAENIOPTERIS WIANAMATTAE, Feistmantel sp.

Pl. xxii., fig. 16.

Macrotaeniopteris wianamattae, Feistmantel, 1878, p. 107, pl. xiii., fig. 2. Tenison-Woods, 1883, p. 118, pl. 10*a*.
Taeniopteris wianamattae, Feistm. sp., Walkom, 1917, p. 38.

Description.—The shape, as far as one can determine, of this incomplete specimen is broadly ovate. The veins are fine, 23 occurring in the space of 1 cm., and they are dichotomously branched towards the margin.

Observations.—This species has already been recorded by Prof. Ralph Tate [11] from Leigh's Creek ("Sweet" Collection), and tentatively by R.

(11) Tate, R., 1893, p. 355.

Etheridge, jun.,[12] from South Australia (Geol. Survey specimens). The Triassic example from Bacchus Marsh, named *Taeniopteris Sweeti* by McCoy,[13] is also referable to the above species.[14]

Distribution.—Ipswich Series: Queensland. Triassic: Victoria (Bacchus Marsh).

Genus Stenopteris, Carruthers, 1872.

Stenopteris elongata, Carruthers.

Pl. xxiii., figs. 17, 18.

Stenopteris elongata, Carruthers, 1872, p. 355, pl. xxvii., fig. 1.
Trichomanides spinifolium, Tenison-Woods, 1883, p. 95, pl. iii., fig. 7.
T. spinifolia, Tenison-Woods, Etheridge, R., *fil.*, 1892, p. 367, pl. xviii., fig. 8.
Frenelopsis (?) sp. ind. (pars), Etheridge, R., *fil.*, 1895, p. 145, pl. vi., fig. 6.
Trichomanites elongata, var. *spinifolia*, Shirley, 1898, p. 19, pl. v., fig. 2.
Stenopteris elongata, Carruthers, Seward, 1903, p. 70, pl. vii., figs. 2, 3; pl. xi., fig. 3. Walkom, 1917, p. 40, pl. i., fig. 1; pl. vi., figs. 1-4*a*.

Observations.—A number of examples of this species are found in the present series, which are preserved both in the black shale and the indurated terra-cotta variety.

Some of the fronds measure as much as 12 cm. in length. The usual form of pinnulation is towards that of the *Sphenopteris* type, that is, rather shorter and blunter than in those usually seen in *Stenopteris elongata*.

The pinnules are frequently deeply incised and show bilobation, or even trilobation, and where the rachis is thick, it is seen to be strongly vertically grooved, whilst the transverse markings, very often met with in this form, are not so much in evidence. The dichotomous branching of the rachis is well seen in these specimens.

These fossil remains bear a close comparison, on the whole, to Queensland specimens, rather than to those from South Africa. They agree in general characters in the shape of the pinnulation exhibited by Dr. Walkom's specimen from Denmark Hill, Ipswich, and figured on pl. vi., fig. 4, of that author's paper. They are distinct from the new species described by W. S. Dun under the name of *Stenopteris rigida*.

The present specimens are evidently those referred to in a list by Professor Tate, made on an exhibit of Mr. Sweet's specimens, before the Royal Society of South Australia, on October 17, 1893, and recorded as *Trichomanides laxum*, Tenison-Woods.

Etheridge, jun.,[15] also figures a specimen under the name of *Frenelopsis* (?) sp. ind., which is referred to on p. 145, *loc. cit.*, as follows:—"The second specimen appears to be the terminal portion of a branch." On examination, this particular specimen shows the elongate-lobate pinnules seen in *Stenopteris*, and the main rachis does not compare closely with *Frenelopsis*.

Distribution.—Ipswich Series: Queensland (chiefly). Walloon Series: Queensland (one specimen only). Hawkesbury Beds: New South Wales. Stormberg Beds (Rhaetic): South Africa. Jurassic: Gippsland, Victoria (recorded by F. Chapman; examples showing the more rigid type of frond with narrower leaflets).

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(12) Etheridge, R., jun., 1891, pp. 10, 11, pl. ii., fig. 3.
(13) McCoy, F., 1898, p. 285.
(14) Chapman, F., 1919, p. 149.
(15) Etheridge, R., jun., 1895, pl. vi., fig. 6.

Genus Phyllopteris, Saporta, 1873.

Phyllopteris Feistmanteli, Etheridge *fil.*

Pl. xxiii., fig. 19.

Phyllopteris Feistmanteli, Etheridge, R., jun., 1892[2], p. 3, pl. i., figs. 1, 2. Dunstan, 1898, pl. v. Walkom, 1917, p. 42, text fig. 12.

Observations.—Although Etheridge does not record this species from the "Sweet" Collection of plant remains from Leigh's Creek, there is one slab showing two leaves, which we refer to the above species. Etheridge's original examples came from Ooroowilanie Swamp, near Nuntha Hill, Cooper's Creek, Central Australia, about 100 miles due north of the Leigh's Creek bore; they were collected by the late Government Geologist, H. Y. L. Brown.

In the present specimens the leaves are ovate-lanceolate, with a rather acuminate apex. The midrib is sulcate, but is not very conspicuous. The veins are rather obscure, but in places are seen to have the forking character of *Phyllopteris* rather than the anastomosing type of venation characteristic of *Linguifolium* of Arber, to which genus that author would refer the present species.

Our specimen differs also from Arber's genotype in the absence of a strong midrib, and the leaf is lanceolate rather than tongue-shaped. In this we are in agreement with Walkom's conclusions in regard to other species of the genus.

Dimensions.—The length of the longer leaf is 46 mm. and the width in the broadest part 21 mm.

Class (?) *GINKGOALES.*

Genus Psygmophyllum, Schimper, 1870.

(?) Psygmophyllum Etheridgei, Arber sp.

Pl. xxiii., fig. 20; pl. xxiv., fig. 21.

Anthrophyopsis ? sp. ind., Etheridge, R., *fil.*, 1895, p. 141, pl. iv., fig. 2.

Chiropteris Etheridgei, Arber, 1917, p. 28.

Description of Type.—In reference to the above, R. Etheridge, jun., has given a full description of one of the specimens before us, and in describing it he remarks that it is a large imperfect frond, and that there is no trace of a midrib, but shows elongated mesh reticulations of the secondary veins, supposing that it belonged to Nathorst's genus, *Anthrophyopsis,* to which he provisionally referred it. Etheridge goes on to describe it as follows:—

"The frond now before me resembles a fish-tail in general outline and expands rapidly towards the distal end. The base of attachment is widely sub-auriculate, the sides of the frond then narrowing and suddenly expanding. The outer or distal extremity of the frond is unknown. There is no midrib, the well-marked neuration radiating and following the outline of the frond. The veins are equal in size, some twice and others thrice dichotomous, certain of them again uniting at long intervals to form an exceedingly elongated hexagonal, or rarely polygonal equal-sized mesh, more particularly in the basal third of the frond; they are slightly thickened immediately before dichotomisation, and the branched or dichotomised vein then slightly bending. On the whole, allowing for the slightly radiate character, the veins may be said to be subparallel."

The dimensions of the type are as follows:—Length, 12·5 cm. Greatest approximate breadth near the apex of the frond, about 6 cm., the frond, however, being imperfect. The average breadth between the veins, which are distinct, is 1 mm.

Observations on New Specimens.—There are five additional specimens in the "Sweet" Collection, which, together with the type, have been presented to the National Museum by Dr. Georgina Sweet. One of these specimens, preserved in brown sandy ironstone, is of an elongate-cuneate shape and has a length

of about 12 cm. Near the base it is constricted and again slightly expanding, the attaching surface being concave. The fish-tail shape referred to by Etheridge is not so well marked as in the type. Although the leaf margins are in most cases imperfect, there are indications which lead one to suppose that it was lacerate or slightly incised. Another specimen preserved in a somewhat cokey shale and appearing as if burnt, shows a fairly broad but imperfect form in which the venation is slightly finer than in the two already referred to; the shape, as far as one can judge, may be elongate-ovate.

The remaining specimens, which are in carbonaceous shale, are too fragmentary to afford much evidence of outline, but clearly belong to the above species.

The above specimen selected by Etheridge for description as referable to *Anthrophyopsis* (?) sp. indet., has been discussed by Newell Arber,[16] who mentions incidentally in his description of *Chiropteris lacerata* from the Rhaetic of Mount Potts, that the above species is also referable to *Chiropteris*, and designates it as *C. Etheridgei*, n. sp.

Another fossil form resembling the above, but of a more broadly cuneate type, was described by Carruthers from the Tivoli Coal Mine, Queensland (Ipswich Series), under the name of *Cyclopteris cuneata;* this species has been referred to the genus *Chiropteris* both by Seward and Newell Arber.

One of the chief characters which appears to distinguish the genus *Chiropteris* from that of *Psygmophyllum* is the presence of the petiole in the former, a feature which is clearly indicated in the original figures illustrating the type. This character is not shown by any of our specimens, the Leigh's Creek examples suggesting rather a non-petiolate form in which the base expands, a character which is common to the Ginkgoales and also to *Psygmophyllum*.

On the interpretation that the specimen belongs to *Psygmophyllum*, the doubtful element occurs in the absence of distinct pinnatisection of the leaf, which, however, may be very easily due to the imperfect condition of the present examples.

Distribution.—The genus *Psygmophyllum* dates from the Devonian and ranges through to the Permian. There are doubtful forms in the Rhaetic.

Genus Sphaereda, Lindley and Hutton (pars.), 1837.

(?) **Sphaereda physaliformis**, n. sp.

Pl. xxiv., fig. 22.

Description.—This seed-like organ is broadly ovate in outline and attached by a portion of one side to a more or less slightly sinuous stem or rachis. The specimen is considerably flattened by pressure during its fossilisation, but a faint ridge-like marking which extends partly across the central area of the seed, and which subsequently diverges, seems to show that the seed was more or less trigonal, as is often the case in the seeds of the living *Ginkgo*.

At the point of attachment with the apex of the stem the granules on the seed-coat converge distinctly. On the under side of the seed, where it drooped from the stem, the margin is slightly re-entrant and seems to indicate the position and presence of a micropyle, by a depression leading on one side to a curved, canaliculate structure.

The outer test, or sclerotesta, is shown by a carbonised layer, which, examined under a lens, is seen to be delicately granulose. Beneath this layer the surface (sarcotesta) is granulose to finely papillate over most of the area.

Dimensions.—Length of pedicel, 18 mm.; width, 2 mm. Greatest diameter of seed, 25 mm.; shortest diameter, 20·5 mm.

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(16) Newell Arber, 1917, p. 28.

Observations.—Comparison has been made with cycadaceous and other seeds which have been referred to the Cycadophyta, but none of the evidence seems to help in the present specimen. The cycadaceous megasporophylls, when petiolate, are affixed to a comparatively rigid stem.

To *Stenorachis*, Saporta, which Professor Seward refers to the Ginkgoales, it bears some definite resemblance in having the ovate seed attached to a moderately slender curved stalk. The seeds of *Stenorchia* are smaller than in the present form, and the sclerotesta differs in being radiately rugose or strongly wrinkled. We therefore return to a consideration of its affinity to *Sphaereda*, Lindley and Hutton, as shown in their pl. clix., fig. 1. In their work on the "Fossil Flora of Great Britain," Lindley and Hutton [17] figure two forms; the lower figure on the plate is different from the upper, and has been referred to as *Beania* by Carruthers.[18] The distinction of *Sphaereda* is that it has a more flexuous rachis and that the lateral supporting petioles curve over the seeds in a partly spiral manner.

In the magnificent "Bean" Collection of Jurassic plants from Yorkshire, in the National Museum, there are some fine examples of *Sphaereda paradoxa*, which show a marked resemblance to the Leigh's Creek specimen.

Shirley has figured a seed from the Ipswich Series of Queensland which seems identical in generic characters with the Leigh's Creek form, under the name of *Beania geminata*,[19] and probably the remaining figures on the plate represent a similar form. Dr. Walkom [20] refers to Shirley's specimens as showing "a general resemblance to *Beania gracilis*, Carruthers."

Class *CONIFERALES.*

Genus Frenelopsis, Schenk, 1871.

(?) Frenelopsis Keith-Wardi, n. sp.

Pl. xxiv., fig. 23.

Frenelopsis (?) sp. ind., R. Etheridge, *fil.*, 1895, p. 144, pl. vi., figs. 4, 5 (non 6).

Description by Etheridge:—"The first specimen consists of a short stem, giving off two branches near its fractured base, then bifurcating, each bifurcation again dividing, one twice, and the other once, near the top of the specimen. The main branch bears fine longitudinal, apparently inosculating striae, but the subsidiary branches are pitted. At the bifurcation two other branches appear to be given off, but the connection is not altogether clear. The counterpart exhibits further interesting details, for the impression, here and there, when the carbonised vegetable matter has been removed, shows faint transverse lines, representing, I believe, articulations both on the main and subsidiary branches."

Etheridge compared this form with *Frenelopsis ramosissima*, Fontaine, of the Potomac younger Mesozoic flora. The slight clue to the affinities of *Frenelopsis* in our species is in regard to the form cited above by Etheridge, but even in that species there are serious differences which separate the Leigh's Creek form, for the former has a definitely jointed stem and the vegetative growth consists of dichotomised stems, whereas in ours there appears to be a main rachis with lateral appendages which, in their possession of a central groove or midrib, appear to suggest the character of leaves. These structures also have a pitted surface, whereas the main rachis is sinuously striated. It is hoped that further specimens will be obtained which will throw additional light on the relationship of this interesting form.

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(17) Lindley and Hutton, 1837, pl. clix., fig. 1.

(18) Carruthers, 1869, p. 97, pl. iv.

(19) Shirley, 1898, p. 16, pl. xx., figs. 1-5.

(20) Walkom 1917², p. 26.

(?) Genus ARAUCARITES, Presl.

Pl. xxiv., figs. 24, 25.

Description.—Two moulds in ironstone fragments are found in this collection which, on taking casts of them, show a striking resemblance to (1) a terminal shoot of a coniferous branch; (2) a cluster of (?) woody scales, suggestive of a cone. Further specimens may clear up doubts in regard to these.

(?) CONIFERALES.

Genus PODOZAMITES, Braun, 1843.

Podozamites Sweeti, n. sp.

Pl. xxiv., fig. 26.

Podozamites sp. ind., R. Etheridge, *fil.*, 1895, p. 144.

Description.—The characters of this species may be briefly described as follows:—Leaf elongate, strap-shaped, tapering at the base, apex unknown. Length, 9 cm.; breadth, 1·3 cm. The lamina traversed by about twelve parallel simple veins, extending the whole length of the leaf. Margin of leaf entire.

Observations.—The late Mr. Etheridge, jun., has already referred to this species as *Podozamites* sp. ind., and has further made these observations upon it. "A single leaf of this well-known genus is in the collection, 3½ inches long, but still imperfect. The base of attachment is shown, and about twelve parallel simple veins, extending the whole length of the leaf, with the interspaces delicately striate. It is probably allied to, and may even be identical with, the protean species *Podozamites lanceolatus.*"

Comparisons.—In comparing this leaf with the figured examples of *P. lanceolatus*, however, it seems that one outstanding differential character is the parallel-sided outline for the main part of the leaf. It tapers towards the base, as in *P. lanceolatus*, but this region in *P. Sweeti* is broader, with a deeply concave margin, and although the leaf narrows, a subpetiolate appearance does not result.

As this form differs in some particulars from *P. lanceolatus*, Lindley and Hutton sp., [21] we are inclined to regard it as a distinct species, and we designate it *Podozamites Sweeti*, after the late Mr. Geo. Sweet, F.G.S., in memory of his indefatigable collecting of the Leigh's Creek fossils.

SUMMARY AND CONCLUSIONS.

The following plant remains have been discussed in this paper. The references in parentheses refer to Etheridge's determinations in 1895:—

EQUISETALES—

- *Equisetites rotiferum*, Tenison-Woods.
- (?) *Equisetites* sp. (stem with strobils).
- *Neocalamites hoerensis*, Hisinger sp.
- *Schizoneura* sp. *a*, Seward (olim *Equisetum* sp., Eth. *fil.*).

FILICALES—

- *Cladophlebis Albertsi*, Dunker sp. (olim *Alethopteris* sp. indet., Eth. *fil.*).
- *Thinnfeldia Feistmanteli*, Johnston (olim *T. odontopteroides*, Eth. *fil.*).
- *Thinnfeldia lancifolia*, Morris sp.
- *Taeniopteris Dunstani*, Walkom (olim *Taeniopteris* sp. indet., Eth. *fil.*).
- *T. Tenison-Woodsi*, Eth. *fil.* sp.
- *T. fluctuans*, Eth. *fil.* (olim *T.* (*? Oleandridium*) *fluctuans*, Eth. *fil.*).

[21] See Seward, A. C., 1900, p. 243, fig. 44.

T. wianamattae, Feistmantel sp.
Stenopteris elongata, Carruthers sp. (olim *(?) Frenelopsis* sp. indet., pars., Eth. *fil.).*
Phyllopteris Feistmanteli, Eth. *fil.*

(?) GINKGOALES—

(?) Psygmophyllum Etheridgei, Arber sp. (olim *(?) Anthrophyopsis* sp. indet., Eth. *fil.).*
(?) Sphaereda physaliformis, n. sp.

CONIFERALES—

(?) Frenelopsis Keith-Wardi, n. sp. (olim *(?) Frenelopsis* sp. indet., pars., Eth. *fil.).*
(?) Araucarites sp.

(?) CONIFERALES—

Podozamites Sweeti, n. sp. (olim *Podozamites* sp. indet., Eth. *fil.).*

Eliminating the species here described for the first time from Leigh's Creek, there are 10 species remaining, *viz.*:—

Equisetites rotiferum, Neocalamites hoerensis, Schizoneura sp. *a, Cladophlebis Albertsi, Thinnfeldia Feistmanteli, T. lancifolia, Taeniopteris Dunstani, T. Tenison-Woodsi, T. wianamattae,* and *Stenopteris elongata.*

Of these, 9 have previously occurred in the Triassic (including the Rhaetic); 5 extend into the Jurassic *(Equisetites rotiferum, Schizoneura* sp. *a, Thinnfeldia Feistmanteli, Taeniopteris Tenison-Woodsi,* and *Stenopteris elongata). Cladophlebis Albertsi* is a Cretaceous form elsewhere.

The age of the Leigh's Creek beds may therefore be safely assumed as Triassic, the flora having a fair proportion of precocious Jurassic types.

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DESCRIPTION OF PLATES XIX. TO XXIV.

PLATE XIX.

Fig. 1. *Equisetites rotiferum*, Tenison-Woods. Stem with two nodes. Nat. size.
,, 2. (?) *Equisetites* sp. Stem with strobils. Nat. size.
,, 3. *Neocalamites Hoerensis*, Hisinger sp. Specimen A. Stem with three nodes and a few leaves. Nat. size.
,, 4. *N. Hoerensis*, Hisinger sp. Specimen B. Grooved stem, with one node, showing leaf bases. Nat. size.
,, 5. *N. Hoerensis*, Hisinger sp. Specimen C. Stem with three nodes. Nat. size.
,, 6. *Schizoneura* sp. Stem with two nodes. Circ. nat. size.

PLATE XX.

Fig. 7. *Schizoneura* sp. Stem with two nodes, showing impressions of leaf bases. Nat. size.
,, 8. *Cladophlebis Albertsi*, Dunker sp. Circ. twice nat. size.
,, 9. *Thinnfeldia Feistmanteli*, Johnston. Portion of frond on black shale, showing wrinkling of the cortex of stem. Nat size.

PLATE XXI.

Fig. 10. *Thinnfeldia Feistmanteli*, Johnston. Frond in ironstone. Nat. size.
,, 11. *T. lancifolia*, Morris sp. Frond nat. size.
,, 12. *Taeniopteris Dunstani*, Walkom. Nat. size.
,, 13. *Taeniopteris*, cf. *Tenison-Woodsi*, Etheridge *fil.* sp. Nat. size.

PLATE XXII.

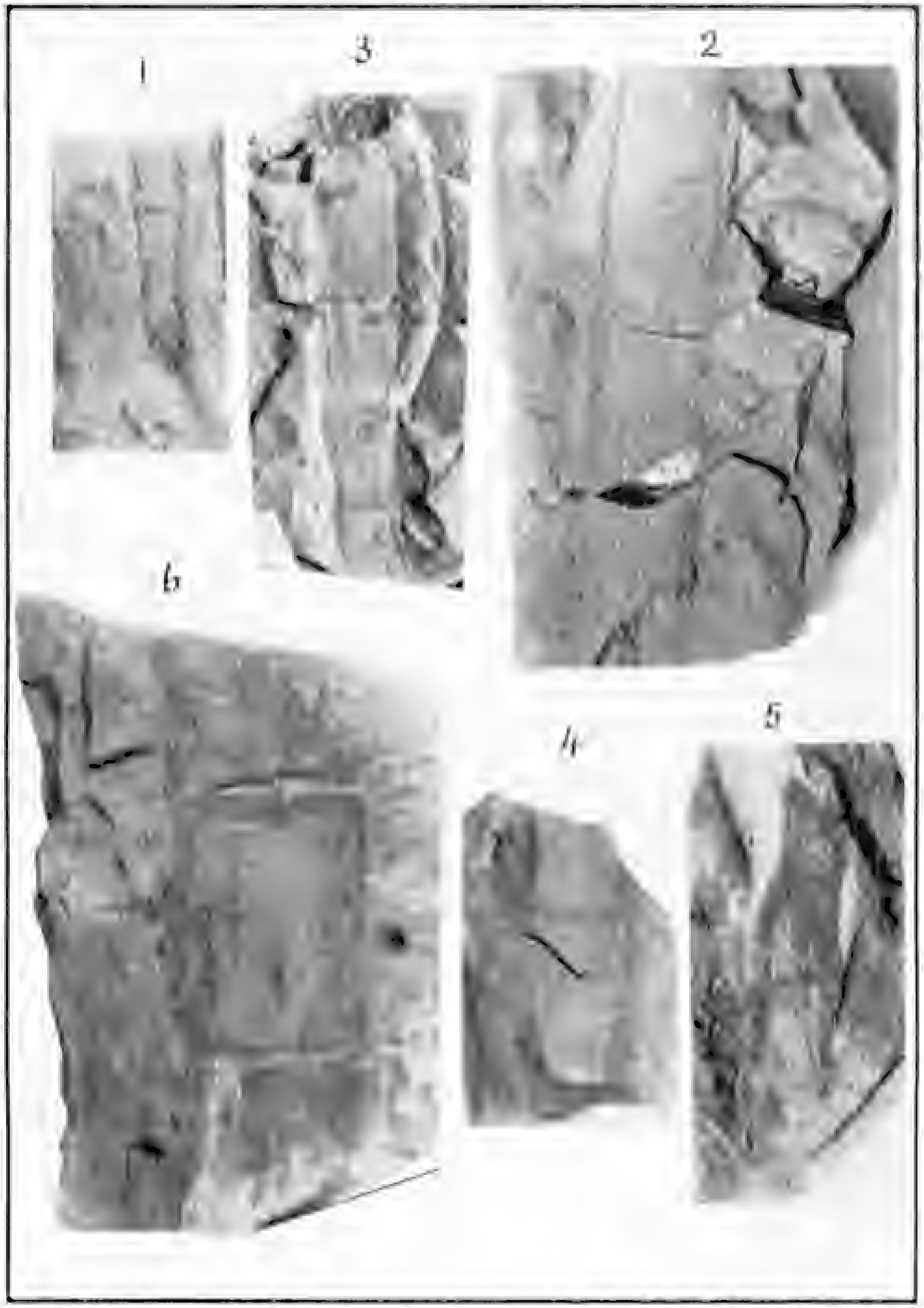
Fig. 14. *Taeniopteris fluctuans*, Etheridge *fil.* An almost complete frond. Nat. size. Holotype.
,, 15. *T. fluctuans*, Etheridge *fil.* A fragment of a frond in ironstone. Nat. size. Paratype.
,, 16. *T. wianamattae*, Feistmantel, sp. A nearly complete frond upon which has been impressed the pinna of a *Thinnfeldia*. Nat. size.

PLATE XXIII.

Fig. 17. *Stenopteris elongata*, Carruthers. Terminal portion of frond. Nat. size.
,, 18. *S. elongata*, Carr. Showing branching of frond. Nat. size.
,, 19. *Phyllopteris Feistmanteli*, Etheridge *fil.* A frond showing the characteristic acute apex. Nat. size.
,, 20. (?) *Psygmophyllum Etheridgei*, Arber sp. Holotype. Nat. size.

PLATE XXIV.

Fig. 21. (?) *Psygmophyllum Etheridgei*, Arber sp. Paratype. Nat. size.
,, 22. (?) *Sphaereda physaliformis*, n. sp. Holotype. Nat. size.
,, 23. (?) *Frenelopsis Keith-Wardi*, n. sp. Holotype. Circ. twice nat. size.
,, 24. (?) *Araucarites* sp. A group of cone scales. Nat. size.
,, 25. (?) *Araucarites* sp. Probably a terminal shoot. Nat. size.
,, 26. (?) *Podozamites Sweeti*, n. sp. Nat. size.



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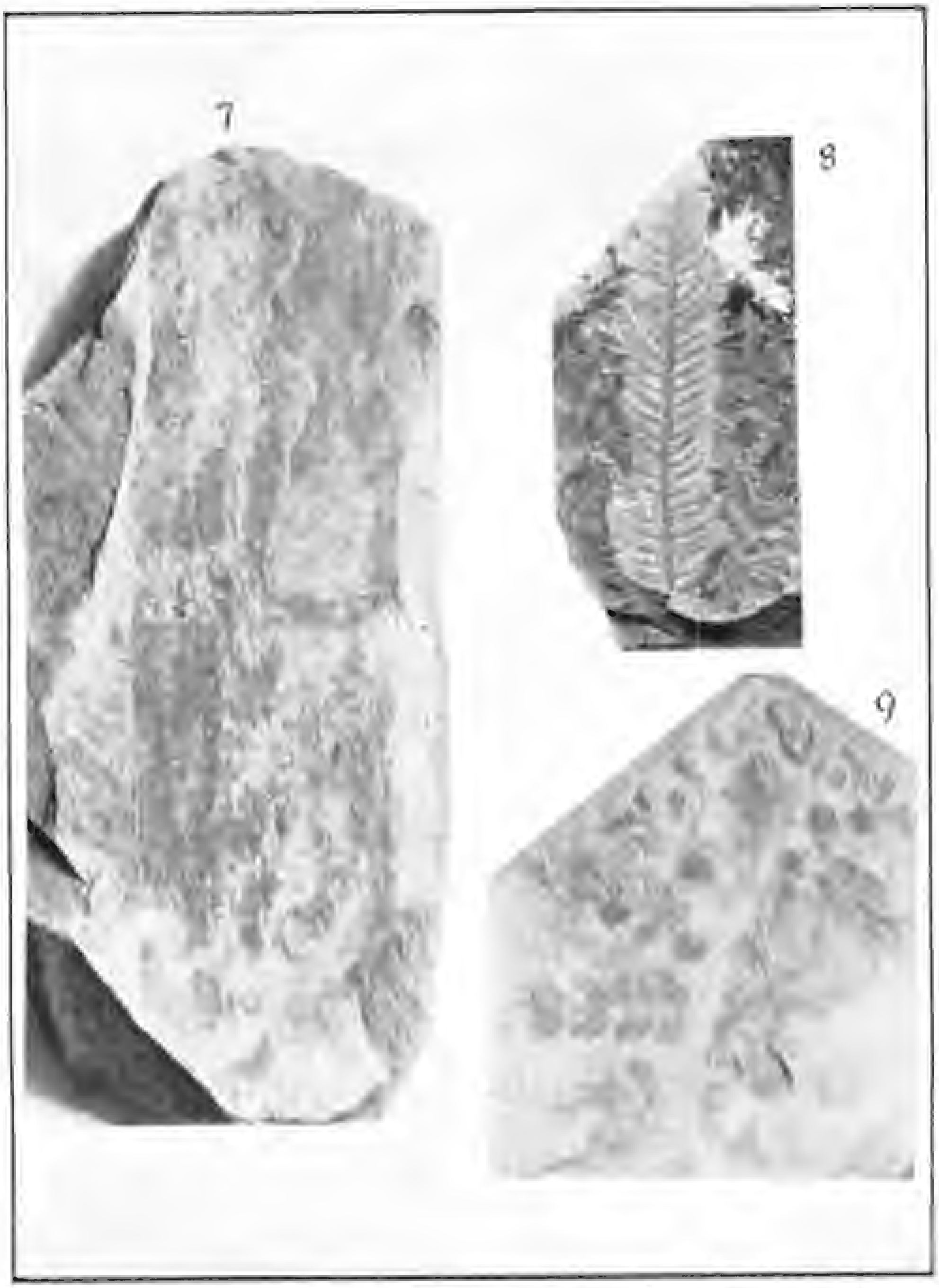

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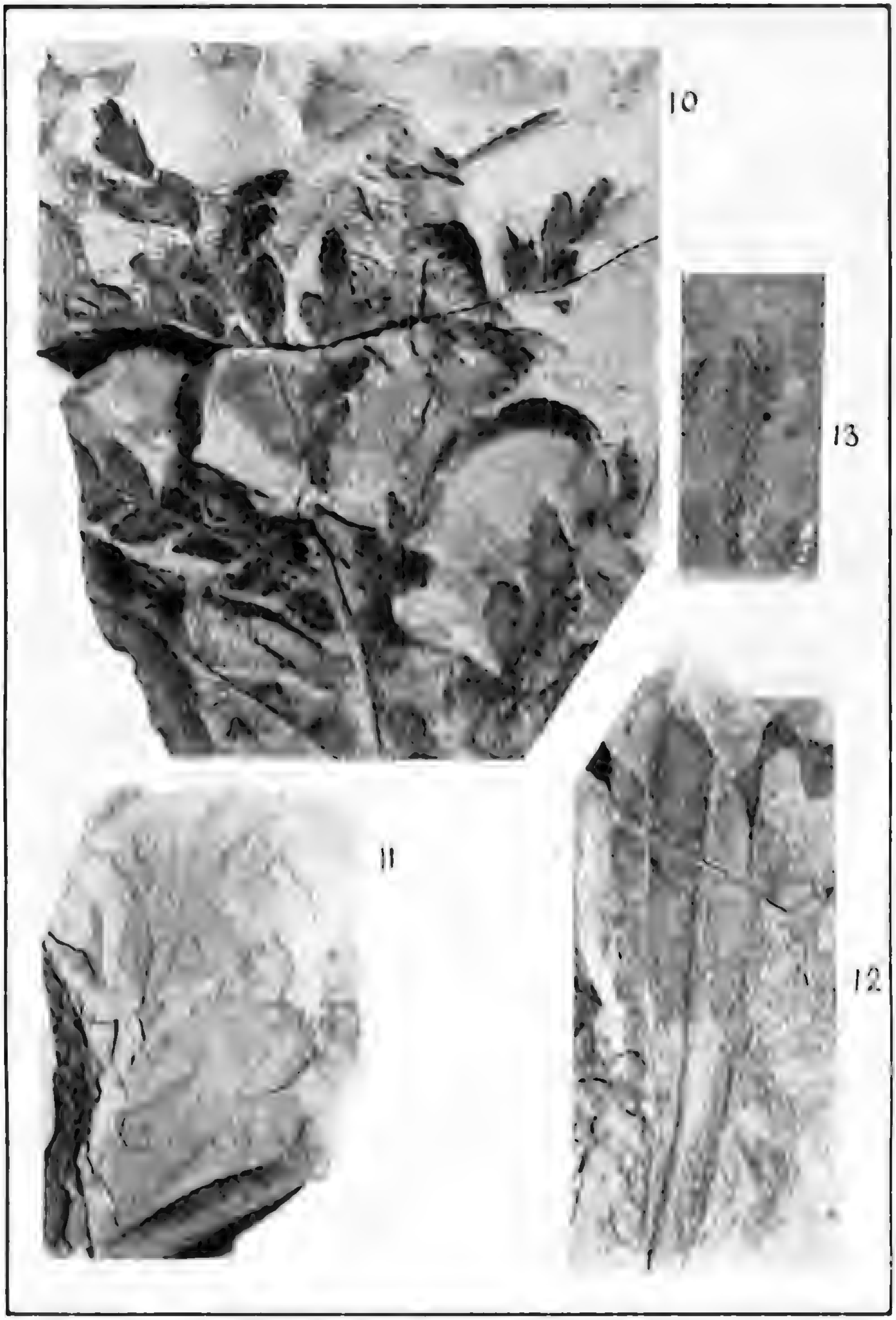

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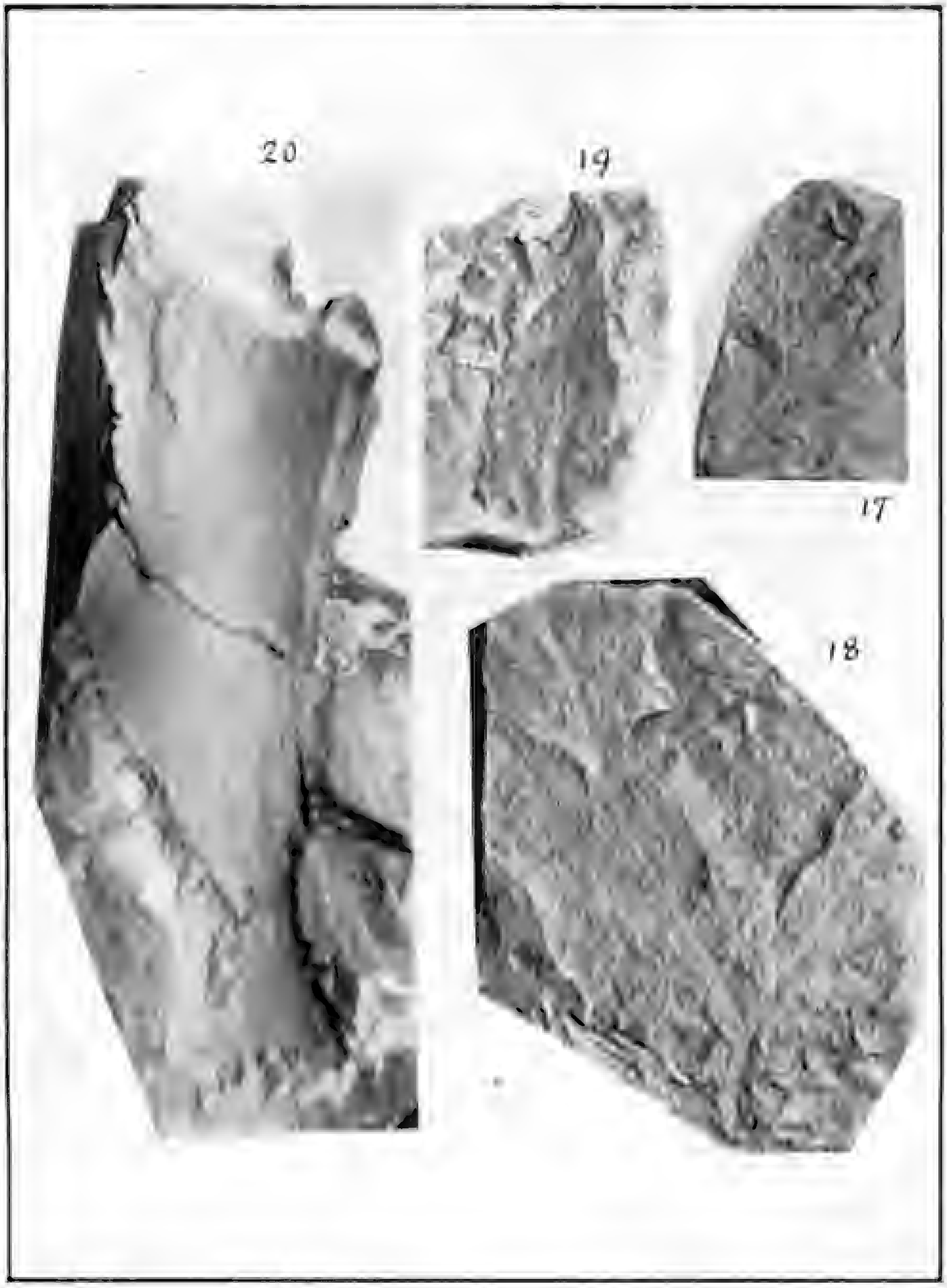

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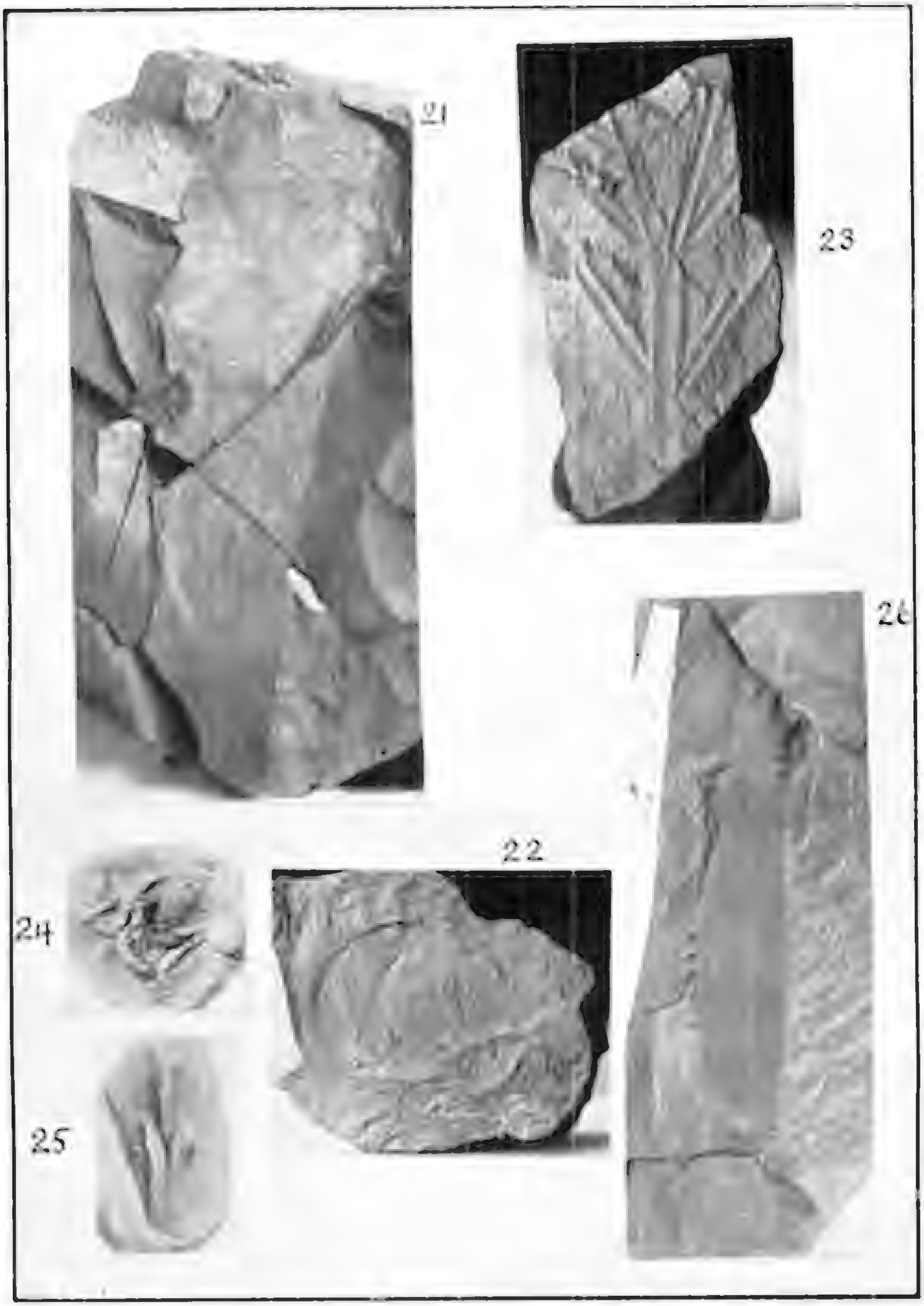

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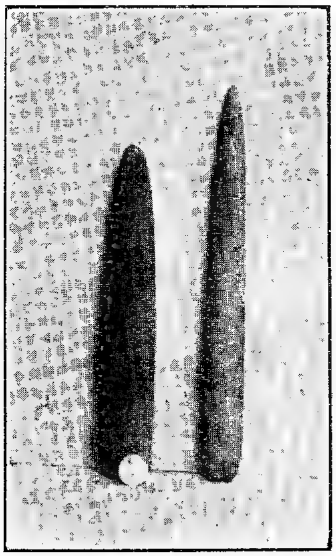
CYLINDRO-CONICAL STONES FROM ARCOONA, PIMBA, SOUTH AUSTRALIA.

By ROBERT PULLEINE, M.B., CH.M.

[Read November 12, 1925.]

The occurrence of Cylindro-Conical Stones in the region west of Lake Torrens is of great interest. The majority of the recorded examples of this form of stone culture have been obtained from the country adjacent to the Darling River and its tributaries. Only isolated specimens have been collected as far afield as Cooper's Creek and elsewhere, the most easterly record to the present time being one from Marree on the northern line.

Arcoona Station, where the specimens described in this paper were obtained, is in lat. 31·5°, long. 137° E. It is some distance from the western shore of Lake Torrens and north of Pimba on the East-West line. The



No. 1. No. 2.

specimens were obtained by Mr. Martin who, having seen a Darling River specimen in my collection, stated that they occurred in his district. He was kind enough to send me one in 1924, and a second in 1925. Although similar in outline to described specimens, they differ in the following particulars:—

1. They are not cupped at the base. 2. They are devoid of markings. 3. They are more slender, having relatively small girth in proportion to their length. 4. The apex is more acute.

Of the specimens figured, No. 1 is of a rough sandstone of dark-yellow colour, the base being 6 inches round and the length 13 inches; No. 2 is of a very fine sandstone, almost a quartzite, with a base of 2½ inches circumference compared with a length of 15¾ inches. Both stones give one the impression of great age, and No. 2 has a thick patina of lighter colour.

ROCK CARVINGS (PETROGLYPHS) AND CAVE PAINTINGS AT MOOTWINGEE, N.S.W.

By Robert Pulleine, M.B., Ch.M.

[Read November 12, 1925.]

Plates XXV. to XXIX.

In recent years the occurrence in South Australia of aboriginal rock carvings or petroglyphs has been recorded by Basedow (1) and Hale and Tindale (2) in the Flinders Range, and more recently by Campbell (3) and Biddle (4) at the Burra. The specimens referred to in the present paper are, apparently, geographically continuous with those described from the Flinders Range.

The objects depicted, as seen in the photographs, were the human form, animals and their tracks, and weapons of the chase.

Mootwingee was visited in October, 1925, by Dr. Macgillivray, of Broken Hill, and the author. The short time at our disposal only allowed of a hurried survey and the photographing of the principal carvings. We were able to get, practically, all those on the main area of occurrence.

The Rock Hole Hotel, which is in the vicinity of the gorge, is 84 miles by road north-east from Broken Hill, and 80 miles due east from the South Australian boundary. The carvings are in Water Reserve 639, as shown in the map. The site can be reached by car from Broken Hill in about four or five hours in good weather.

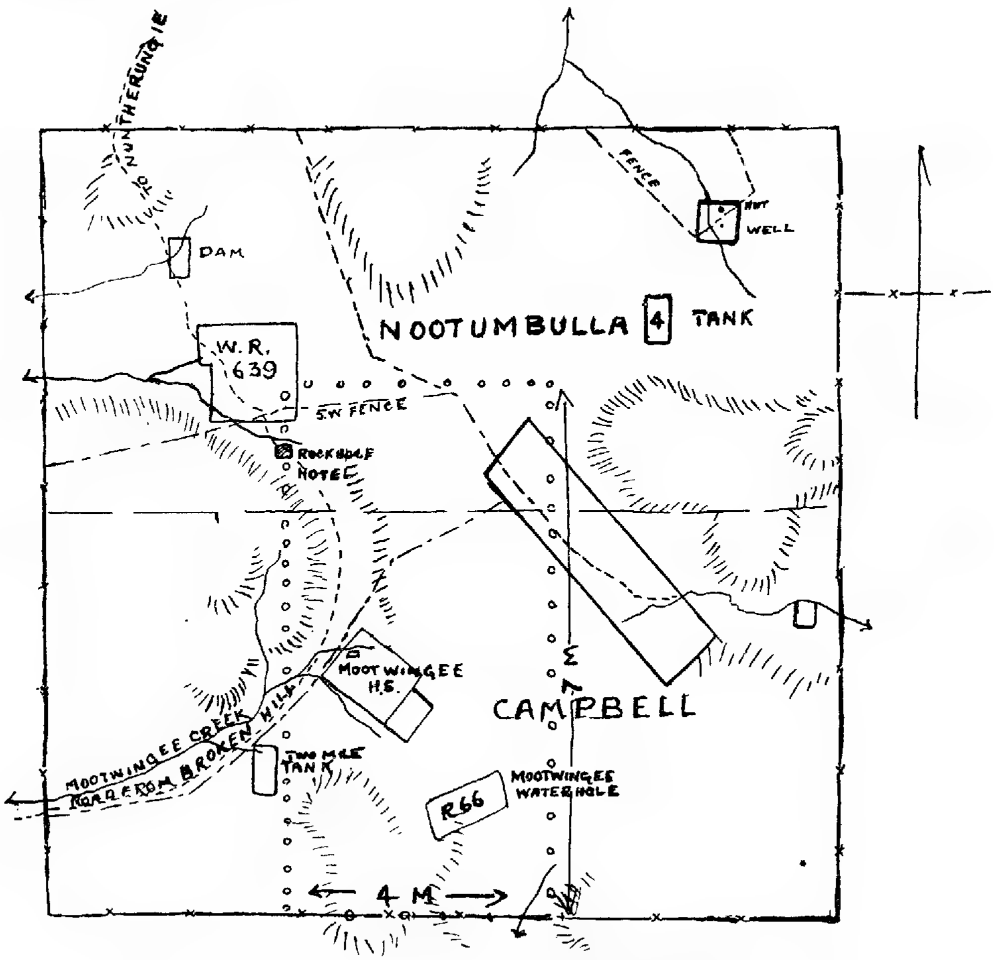
The Field Naturalists' Club of Broken Hill has petitioned the New South Wales government to proclaim the whole area in which carvings and paintings occur a reserve. This is necessary to prevent destruction of the main rock site, which has already begun.

The gorge in which the petroglyphs occur is a very interesting one. Cut out of the dense sandstone rock, it has in its bottom a chain of waterholes in rocky caverns sheltered from the sun and are of great capacity. The rock cisterns are flanked by the smooth quartzite slopes which act as a very efficient catchment of considerable area, so that the fall of even a few points of rain is sufficient to replenish the holes. The value of this and a few adjacent areas to the aboriginals, especially in times of drought, was inestimable, as the nearest point of the Darling was at least seventy miles away. In times of drought they would probably be more or less obliged to remain in the locality on account of the water and the food animals the water attracted. This fact, and the existence of an extensive slope of hard, polished rock, gave them the leisure and the site on which to depict their ideas of form.

It has long been observed that petroglyphs are found in places where a prolonged occupation in a state of leisure and inactivity has been possible, as would occur in the area under consideration. The petroglyphs have been produced by a technique which has been apparently universal—a pecking at the rock with a harder stone, such as a stone axe, without subsequent smoothing off. In some of the illustrations this can be easily observed.

Some of the drawings are apparently of great antiquity, two in the bed of the creek especially so, and a spiral on the vertical rock face was almost invisible and did not come out on the photograph. The sloping rock at the edge of the water, more polished than the rest, is absolutely covered with carvings so thickly as to be indecipherable. Here evidently the rock face

was, from its convenient position and closeness to the water, a favourite drawing block for the idle aboriginal, who made new scratches regardless of the old. Thus we find on this block impressions of varying degrees of sharpness and antiquity.



Plan of W.L.L. 1475, County of Mootwingee.

Scale, 2 miles to 1 inch. Approximate area, including Native Carvings, Stencilling, and other Inscriptions, shown thus: oooooooooo

Rock Hole Hotel, 84 miles by road from Broken Hill and 80 miles due east of S.A. boundary.

None of the petroglyphs are, apparently, very recent, and were probably made when the rock slope was in better condition than now, as the cleavage has made large longitudinal and transverse cracks, so that several blocks with drawings on them are movable. Apparently, too, the colonist has, between 1860—when Sturt formed a depôt in the gorge- and the present day, helped in the destructive process.

The Cave Paintings.

Adjacent to the gorge where the petroglyphs are found are several caves caused by the weathering away and falling in of the sandstone. These caves are very large and face north. The overhang must have been very useful for

shelter in inclement weather. It is on the lower part of the walls of these caves that the paintings occur. The technique, as in other localities in Australia, is that of stencilling, and the hand is by far the most frequent object. Hands of all sizes, from adults to infants, are portrayed, boomerangs frequently, once a shield, and in one cave a snake 28 feet long.

The latter may have been made by holding the same snake up more than once. The technique seems to have been to hold the hand with fingers widely separated on the white sandstone and blow red ochre over it, it is said with the mouth. The hand or other object therefore appears as a white object on a coloured ground. In two large caves visited at Mootwingee hands were exhibited in hundreds, while the foot, though present, was rarely shown. The pictures are indelibly fixed and form part of the rock.

On Mena Murtie Station, near Wilcannia, visited *en route* to Mootwingee, a single cave was found in the Peveril Hills. Here the range is formed of a coarse boulder conglomerate, and in a low cave facing due south a series of hands was depicted by the same means, though the conglomerate was inferior to the white sandstone as a background.

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Map of Mootwingee showing Rock Hole Hotel and Water Reserve 639 to the north of it.

DESCRIPTION OF PLATES XXV. to XXIX.

Plate XXV.

Fig. 1. Detached slab placed vertically to photograph showing lizard (varamis) kangaroo tracks, human figure, emu eggs, boomerangs, and other markings.

Fig. 2. The same chalked.

Plate XXVI.

Fig. 1. Slab showing boomerang and human figures.

Fig. 2. Showing large human figure, hawks, marsupial tracks, and a ladder-like object.

Plate XXVII.

Fig. 1. Showing general fissured condition of rock face with kangaroo, human figures, many tracks of emu and marsupials, boomerangs, etc.

Fig. 2. Kangaroos, boomerangs, and tracks.

Plate XXVIII.

Fig. 1. Showing kangaroo and tracks, emu eggs, and boomerangs.

Fig. 2. Two objects, opossum on flat rock in bed of creek, much water worn.

Plate XXIX.

Fig. 1. General view of large cave. The paintings are on the line behind the heads of the figures.

Fig. 2. A short section of the paintings showing hands in great numbers and marsupial tracks.

Fig. 1.

Fig. 2.

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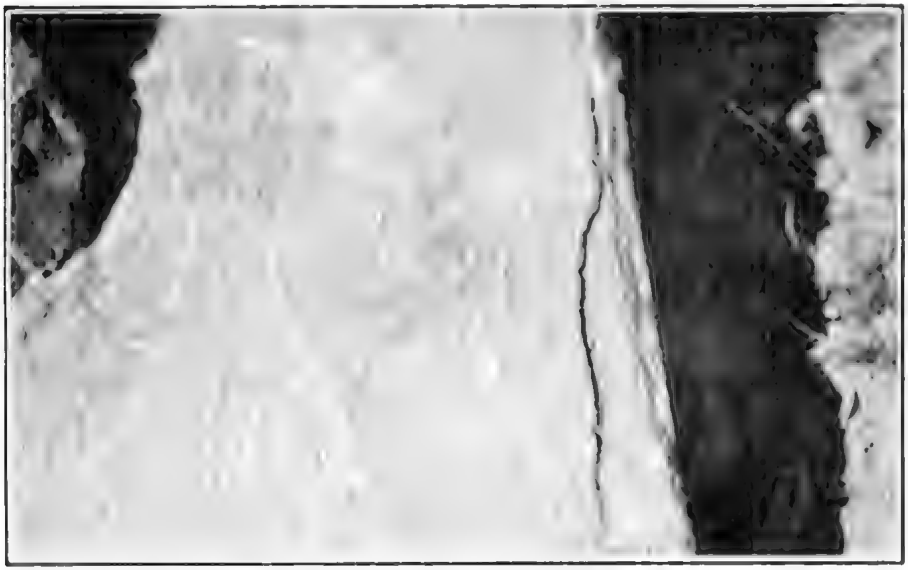

Fig. 1

Fig. 2

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Fig. 1

Fig. 2.

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Fig. 1.

Fig. 2.

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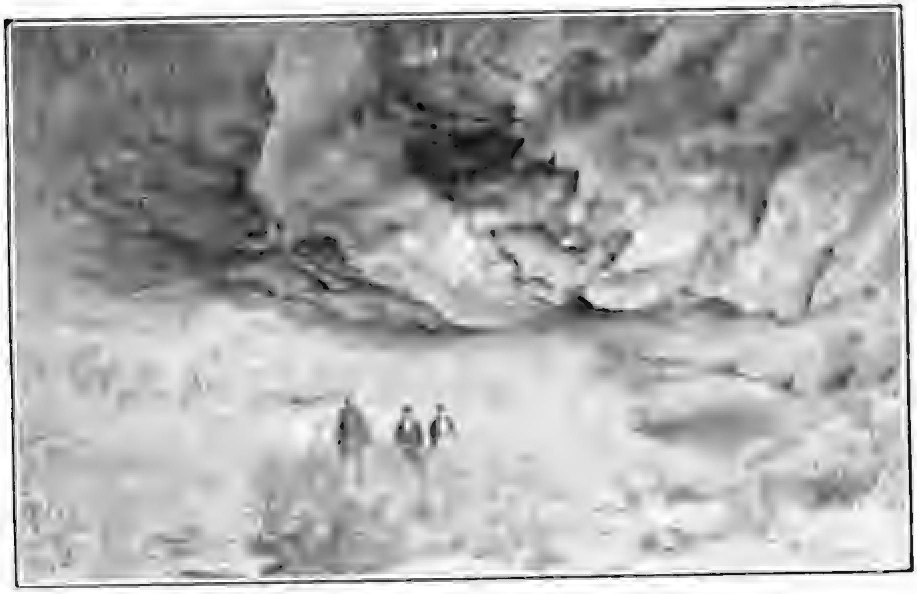

Fig. 1.

Fig. 2.

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THE ABORIGINES OF SOUTH AUSTRALIA: ANTHROPOMETRIC, DESCRIPTIVE, AND OTHER OBSERVATIONS RECORDED AT OOLDEA.

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[Read July 8, 1926.]

Plates XXX. to XXXII.

The observations recorded in this paper form a continuation of the systematic work by members of the University of Adelaide staff which was commenced during a brief preliminary survey in November, 1925.

The number of individuals examined was not large owing to limited time and the smallness of the party, but in all their observations the present writers endeavoured to satisfy the requirements of modern anthropological research as far as conditions in the field permitted, and it seems to them that where the necessity for recording facts about our aboriginals is so obvious and urgent the limited scope of any observations should not be a bar to their publication.

For the provision of certain equipment we are indebted to Professor F. Wood Jones and Dr. Robert H. Pulleine, while to Mr. James Way, of Ooldea, and Mr. A. J. McBride, of Wilgena, our thanks are due for their interest in our undertaking and the facilities they so generously provided.

The Natives.—The individuals examined in detail were about half of those who formed a more or less permanent camp at Ooldea, on the edge of the Nullarbor Plain. They live in a partly civilised condition, seldom going far from the railway. Most of their food is obtained from white people, the rest by hunting. The adults wear many layers of clothing, which they are reluctant to discard, so that the identification of bony landmarks is difficult and a complete examination of the body for physiological and pathological data almost impossible. Iron tools are used for the fashioning of weapons, and their old social system seems to be as little practised as their stone culture.

Many of the natives have come in from the back country during recent years and belong to groups which roamed the area lying between the Trans-Australian Railway and the Musgrave Ranges. Most of them belong to the Alinjera group, but a few of those recorded belong to the Willoorara group. It is very doubtful if there are any left at all who belong to the group originally occupying the Ooldea region. However, as to the actual distribution and names of the groups occupying this region of the State, it is expected that some definite information will be published in the near future.

Names and Ages.—The number of natives dealt with in our observations was twenty-eight (28), of whom eleven (11) were males and seventeen (17) females. A general age grouping is as follows: 3 aged, 17 adults, 5 young adults, and 3 children. The ages recorded in the table are, of course, only approximate in most cases, but all care was taken in endeavouring to get a reasonable estimate; in the younger people, inspection of their teeth helped towards accuracy.

The key letters to the subjects, their names, ages, etc., are set out in Table I.

Anthropometry.

Measurements recorded.—The measurements were made in accordance with the recommendations of the International Agreement, Geneva (1912), for observations on the living subject, and the series chosen is almost identical with that used by Professor F. Wood Jones and one of the present writers in a previous communication (1). The present authors feel impelled to express their concurrence with the opinion that some of the measurements usually recorded are

almost useless. The difficulty in ascertaining accurately such a landmark as the upper border of the great trochanter, for instance, the possible range of error in one worker's findings, as well as the difference between those of different workers, render the value of such figures for comparative study very doubtful.

The actual measurements recorded in the present work are given in Table II. The figures given for the upper and lower extremities represent the distance of the landmark from the base when the subject is standing upright.

TABLE I.

Subjects examined.

Key.	Sex.	Age.	White Name.	Native Name.	Tribe Group.
A	Female	30	Mary	Ineeah	Alinjera
B	Female	35	Connie	Narribingoo	"
C	Female	—	Lucy	Ginomga	"
D	Female	aged	Judy	Goondunya	"
E	Male	40	Charlie	Quiermo	"
F	Female	16	Grace	Bildah	"
G	Female	35	Nellie	Bitji	"
H	Male	40	Long Jimmy	Ungeri	Willoorara
I	Female	15	Lena	Kniddendunna	Alinjera
J	Female	15	Melva	Kumjedah	"
K	Female	18	Nellie	Wallerwara	———
L	Male	30	Mick	Altchena	Karnga (W.A.)
M	Male	25	Tommy	Inyagoodji	Alinjera
N	Male	35	Toby	Wolguri	"
O	Male	45	Peter	Nginina	"
P	Male	aged	Old Billy	Moondal	Willoorara
Q	Male	26	Tommy	Nutabie	Alinjera
R	Female	28	Mary	Tunguna	"
S	Female	17	May	Walinga	"
T	Female	20	Maudie	Igidah	"
U	Female	35	Lucy	Ingnali	"
V	Female	35-40	Nellie	Djilla	Willoorara
W	Female	aged	Topsy	Dilgerra	Alinjera
X	Male	50	Bill	Tutswai	"
Y	Female	25	Maggie	Kurrikur	"
Z	Male	10	Leslie	Lijili	"
AA	Female	12	Mary	———	———
BB	Male	7	Ernie	———	———

TABLE II.

Body	1. Stature.		18. Intercanthal minimum.
	2. Height to supra-sternal notch.		19. Bi-orbito-nasal-arc
	3. Shoulder height.	Nose	20. Length.
	4. Arm span.		21. Breadth.
	5. Sitting height.		22. Height.
	6. Shoulder breadth bia-cromial.	Ear	23. Length.
	7. Shoulder breadth bihumeral.		24. Breadth.
Head	8. Length.	Mouth	25. Breadth.
	9. Breadth.	Arm (from base)	26. Acromion.
Face	10. Height.		27. Elbow.
	11. Height menton-nasion.		28. Wrist.
	12. Height menton-crinion.		29. Finger tip.
	13. Diameter bizygomatic.	Leg (from base)	30. Anterior superior spine.
	14. Diameter minimum frontal.		31. Great trochanter.
	15. Diameter bigonial.		32. Knee.
	16. Interorbital maximum.		33. Ankle.
	17. Intercanthal maximum.	Hand	34. Length.
			35. Breadth.
		Foot	36. Length.
			37. Breadth.
			38. Girth lower leg.

Instruments employed.—All measurements were secured with Martin's stature rod, spreading callipers, and sliding compass; certain measurements were taken with a non-metallic millimetre tape. The full table of measurements is given below; the individuals are represented by the letters A to Z (AA and BB were not measured) as in Table I., and the measurements by the numbers given in Table II. All measurements are recorded in millimetres.

Mean Values.—In the final column of Table III. are given the mean values of our measurements. For purposes of comparison we give below a few of the more important mean values alongside the results which Wood Jones and Campbell compiled from their own and previous workers' figures.

MEAN VALUES.

Observation.	Campbell and Lewis. Number of Individuals.	Mean.	Wood Jones & Campbell. Number of Individuals.	Mean.
Stature	25	1593·4	309	1636·9
Cranial length . .	25	187	173	187·9
Cranial breadth	25	135	173	137·6
Nose height . .	25	43·2	10	44·6
Nose breadth .	25	44·8	10	46·3

In deriving the mean values, subject Z, a boy of 12, has been omitted.

Indices.—From our observations we have derived several of the more important indices, believing that, although the total number of individuals is not great, these results would be interesting when compared with those obtained by previous workers. The results tabulated below are placed beside those given in the previous paper by Wood Jones and Campbell.

MEAN OF INDICES.

Index.	Campbell and Lewis Number of Individuals.	Mean.	Wood Jones & Campbell. Number of Individuals.	Mean.
Cephalic	25	72·2	81	73·3
Facial	25	81·7	51	86
Nasal	25	104·6	81	100·7
Ear	25	53·1	50	56·6
Radio-humeral	25	81·5	10	81·4

It will be seen from the above figures that the proportions observed in the present group of individuals approximate very closely to those obtained on previous groups examined, and go to confirm the assertion that the aborigine of Central Australia, at any rate, belongs to a pure stock with well-defined and constant physical characters.

He is dolichocephalic, platyrhinic, and dolichokerkik; the breadth of his ear is about half its length, while as to his face, the mean index is fairly constant, though there is a considerable individual variation; this was also evident from general and photographic observations.

TABLE III.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	Mean.
1	1555	1463	1508	1540	1567	1582	1641	1762	1516	1542	1561	1647	1693	1635	1648	1627	1651	1520	1548	1538	1580	1622	1567	1730	1592	1383	1593·4
2	1312	1230	1290	1320	1290	1332	1390	1474	1271	1350	1289	1389	1401	1375	1384	1368	1380	1270	1292	1299	1253	1357	1313	1412	1318	1100	1334·4
3	1320	1230	1275	1314	1275	1303	1391	1488	1244	1350	1295	1372	1420	1356	1406	1376	1368	1308	1283	1302	1260	1377	1342	1448	1338	1142	1337·6
4	1616	1565	1628	1585	1660	1640	1732	1865	1577	1622	1599	1721	1735	1762	1799	1731	1726	1574	1682	1681	1576	1714	1650	1873	1657	1470	1678·8
5	701	765	723	741	743	760	789	858	732	762	772	761	852	767	743	820	850	742	758	759	770	767	752	846	754	—	771·5
6	313	304	314	—	320	310	298	353	303	268	250	324	332	328	347	372	366	299	297	359	341	317	307	356	271	—	305·9
7	329	330	354	370	328	355	341		327	296	257	375	394	378	411	382	410	355	331	380	384	342	375	413	335	310	342·1
8	188	193	173	178	185	182	186	199	182	188	178	185	192	192	172	200	198	182	186	186	186	192	188	205	179	188	187
9	137	133	125	136	140	142	131	145	129	135	128	139	136	132	128	143	146	126	131	135	137	136	130	143	132	141	135
10	128	114	106	94	127	132	123	—	113	—	123	138	126	120	117	128	132	121	96	121	112	124	115	144	113	135	110·7
11	106	95	108	103	107	104	100	109	97	96	103	106	114	114	122	113	117	103	107	103	111	106	97	126	101	—	106·7
12	176	162	168	166	192	158	158	194	154	161	173	183	202	207	211	202	196	156	165	175	179	175	162	213	163	—	178
13	114	131	119	130	141	132	122	152	122	124	131	134	132	131	134	139	138	117	126	136	133	128	128	145	131	124	130·8
14	105	117	102	110	110	112	109	109	104	113	112	105	114	107	117	119	119	101	106	122	113	106	105	117	110	110	110·6
15	90	100	87	88	100	112	92	112	90	81	97	100	102	100	104	107	104	65	104	100	95	91	96	112	100	76	97·2
16	111	118	110	113	115	112	107	117	110	106	111	115	120	118	120	125	117	103	110	120	108	114	111	120	116	112	113·9
17	86	94	86	82	84	87	89	95	88	89	91	94	88	98	85	96	100	84	96	91	92	89	91	99	91	87	90·6
18	34	33	35	35	27	31	33	39	30	32	36	38	36	37	33	43	38	28	31	34	38	31	35	38	33	33	34·3
19	128	120	120	120	130	120	132	148	132	132	132	142	140	148	143	145	140	122	135	132	132	125	132	145	140	—	133·4
20	34	31	30	41	45	40	34	42	36	29	34	39	40	34	58	32	39	36	38	30	34	40	30	38	36	33	36·8
21	42	45	39	40	50	40	41	55	38	40	45	45	51	50	45	53	48	41	46	44	46	43	45	47	42	39	44·8
22	43	40	43	42	45	40	38	48	39	40	43	46	45	47	60	40	46	39	44	36	46	45	37	48	39	39	43·2
23	57	64	60	66	69	52	58	66	62	60	57	59	61	55	70	67	58	55	60	67	60	60	64	69	61	63	61·5
24	26	36	33	35	28	32	29	38	32	33	28	33	35	32	34	37	33	29	31	35	29	31	32	38	36	37	32·6
25	52	60	55	60	54	47	62	71	56	55	61	62	61	65	58	75	64	56	60	55	61	55	55	69	57	52	59·4
26	1312	1230	1275	1314	1275	1303	1391	1488	1244	1350	1295	1372	1420	1356	1406	1376	1368	1308	1283	1302	1260	1377	1342	1448	1338	—	1337·3
27	1002	981	971	1024	1002	1052	1082	1142	955	1042	1014	1030	1083	1056	1061	1053	1041	986	1003	1010	1010	1048	1053	1101	1044	—	1033·8
28	733	742	739	800	752	814	837	860	710	795	775	799	822	785	810	823	794	777	741	794	743	817	827	837	796	—	788·9
29	590	504	549	619	589	620	646	668	522	580	580	608	611	611	605	642	623	608	548	609	594	634	624	609	603	—	599·8
30	930	893	928	936	951	966	1002	1051	960	930	907	992	1002	960	975	1012	938	914	907	958	894	975	946	1030	953	—	956·4
31	822	884	849	850	874	953	953	1002	845	865	846	916	973	875	905	958	841	838	851	871	893	899	846	888	881	—	887·1
32	460	411	435	446	457	465	504	517	432	456	438	486	486	483	495	476	471	432	434	440	411	460	453	501	472	—	461·2
33	60	66	56	64	76	58	55	77	56	63	55	69	73	76	81	65	82	53	60	70	58	57	55	76	77	—	65·6
34	168	160	166	166	172	175	177	200	164	178	173	179	188	177	188	181	180	163	178	177	159	170	166	189	170	156	174·6
35	71	80	74	77	76	76	70	96	72	74	68	85	84	88	80	84	86	74	72	86	72	74	75	90	73	72	78·3
36	228	213	221	230	241	243	243	274	231	252	240	289	260	223	263	259	248	230	232	234	228	242	238	257	235	221	242·2
37	84	83	86	88	90	92	85	103	79	95	83	96	98	102	97	92	99	88	80	90	93	90	88	107	89	84	91·1
38	250	265	260	284	290	350	280	325	256	315	255	275	320	275	292	310	328	248	250	308	280	280	273	354	250	—	268·9

Descriptive Observations.

In addition to the measurements, descriptive notes were made on each subject examined. These included colour of skin, eyes, and hair, scars, body build, lips, supraorbital ridges, etc.

For our observations on colour we were, unfortunately, not equipped with standard colour guides. We have, therefore, endeavoured to follow the suggestions of Hrdlicka (2).

The presence of ochre often made it difficult to fix on a shade of colour.

"Limbic rim." A rim of pigment around the limbus corneae was so frequent a finding that it was thought advisable to record its presence.

The descriptive observations are set out in Tables IV. and V.

Pathological Observations.—The opportunity was taken to record any pathological findings, but in most cases only the head and the distal parts of the extremities were accessible to examination.

A large proportion of the aborigines examined had some ocular lesion. Several comparatively young people had milkiness of the lens, associated with slight impairment of vision. Trauma had been responsible for blindness and corneal opacities. No signs of trachoma were observed, but many of the young children had subacute catarrhal conjunctivitis and marginal blepharitis. The prevalence of flies and the nonchalance with which the natives allow them to settle about the face, especially the inner canthi, may contribute to this. Pterygia were fairly prevalent.

Examination of the heart was made on four of the aborigines, and the pulse of others were felt. There was remarkable freedom from cardiovascular disease, as far as one could judge.

A sick man in the camp was examined the day before he died; he was stuporose and had signs of a basal pneumonia, probably terminal. No other cause for his condition could be discovered.

The lesions found are recorded in the following schedule:—

A. Slight pterygium. Small black naevi on both forearms, one on neck. Long linear scars on leg and behind knee (said to be due to burns).

C. Left eye blind (from injury in early life). Fingers clubbed.

D. Cataract in both lenses. Pulse regular, good volume and tension. Artery wall not thickened. Fractured radius (old), no callus palpable.

G. Pterygium in both eyes. Nebula in left cornea. Pupils very contracted.

H. Heart and lungs: nothing abnormal detected. Second toe the longest in each foot. Slight baldness of vertex.

K. Internal pterygium of left eye.

L. Cardiovascular system: nothing abnormal detected. Fingers very clubbed.

M. Slight opacity of right lens. Vision in left eye better than in right. Both corneae oval. Cardiovascular system: nothing abnormal detected.

O. Arcus senilis in right eye. Left globe shrunken.

P. Pterygium in right eye. Cataract in both lenses. Mitral systolic murmur at apex, traceable out to axilla; otherwise nothing abnormal detected on examination of heart. Pulse 70, regular; radial artery not thickened.

Q. Lipoma on left side of the forehead 2 inches above the external canthus.

Table IV.

Subject.	Skin Colour. Face.	Skin Colour. Arm.	Eye Colour. Iris.	Eye Colour. Sclerotic.	Eye Colour. Limbic Rim.
A ..	Light chocolate	Dark purple-brown	Dark brown ..	Dirty yellow ..	Absent ..
B ..	Medium chocolate	—	Very dark brown	Yellowish ..	—
C ..	Light chocolate	Light yellowish-brown	Black	Dirty yellow ..	—
D ..	Light chocolate	Light chocolate	Black	Dirty yellow ..	—
E ..	Light chocolate	Light chocolate	Dark brown ..	Dirty yellow ..	Present ..
F ..	Light chocolate	Light greyish-brown	Dark brown ..	Dirty yellow ..	—
G ..	Medium chocolate	Greyish-brown	Dark brown ..	Yellowish ..	—
H ..	Dark chocolate	Medium chocolate	Dark brown ..	Dirty yellow ..	Yellowish-brow
I ..	Light chocolate	Greyish-black	Dark brown ..	Light yellowish	Yellowish-brow
J ..	Light chocolate	Light purplish-brown	Dark brown ..	Yellowish ..	Light ylwsh.-brw
K ..	Light chocolate	Light greyish-brown	Dark brown ..	Yellowish ..	Brown ..
L ..	Medium chocolate	Medium chocolate	Dark brown ..	Dirty yellow ..	Wide rim
M ..	Light chocolate	Light greyish-chclate.	Medium brown	Dirty yellow ..	Brown ..
N ..	Dark chocolate	Brown-black	Dark brown ..	Dirty yellow ..	Present ..
O ..	Light chocolate	Light chocolate	Dark brown ..	Dirty yellow ..	—
P ..	Brown-black	—	Medium brown	Dirty yellow ..	—
Q ..	Light chocolate	Light chocolate	Dark brown ..	Dirty yellow ..	Slight rim
R ..	Dark chocolate	Dark chocolate	Medium brown	Dirty yellow ..	—
S ..	Medium chocolate	Reddish chocolate	Medium brown	Light yellow ..	Brown ..
T ..	Dark chocolate	Brown-black	Medium brown	Dirty yellow ..	—
U ..	Light chocolate	Light chocolate	Medium brown	Light yellow ..	—
V ..	Dark chocolate	Light chocolate	Dark brown ..	Dirty yellow ..	—
W ..	Dark chocolate	Dark chocolate	Dark brown ..	Light yellow ..	Present ..
X ..	Dark chocolate	Medium chocolate	Dark brown ..	Yellow	Absent ..
Y ..	Light chocolate	Light chocolate	Dark brown ..	Yellow	Present ..
Z ..	Light chocolate	Light chocolate	Medium brown	Yellow	—
A A ..	Light chocolate	—	—	—	—
B B ..	Very light chocolate	—	Dark brown ..	Dirty yellowish	Present ..

Table V.

	Hair. Face. Amount.	Hair. Face. Colour.	Hair. Chest.	Hair. Eyebrows. Amount.
A ..	Very scant	—	Nil	Very scant
B ..	Nil	—	Nil	Scant
C ..	Scant	Black	Nil	Scant
D ..	Nil	—	Nil	Scant
E ..	Moustache and whiskers	Brown-black	—	Medium
F ..	Slight moustache	Black	Nil	
G ..	Slight	Black with grey	Nil	Scant
H ..	Whiskers and moustache	Black with white (shaved)	Marked; grey ..	Marked
I ..	Nil	—	Nil	Scant
J ..	Nil	—	Nil	Scant
K ..	Nil	—	Nil	Medium
L ..	Copious whiskers and moustache ..	Black	Scant	Medium
M ..	Copious whiskers and moustache ..	Black	Medium; black	Medium
N ..	Scant whiskers, copious moustache	Black	Medium ..	Medium
O ..	Whiskers and moustache	Black	Medium ..	Medium
P ..	Copious whiskers and moustache ..	Grey	Marked; white	Medium
Q ..	Copious whiskers and moustache (cut)	Black	Marked ..	Medium
R ..	Very sparse	—	Nil	Scant
S ..	Nil	—	Nil	Medium
T ..	Nil	—	Nil	Sparse
U ..	Slight on upper lip	—	Nil	Medium
V ..	Very sparse	—	Nil	Scant
W ..	Upper lip medium, sparse	—	Nil	Scant
X ..	Whiskers and moustache	Black with grey	Marked; black	Marked
Y ..	Upper lip sparse	—	Nil	Scant
Z ..	—	—	Nil	Medium
A A ..	Nil	—	—	Scant
B B ..	Nil	—	Nil	Scant

Table IV.

Body Build.	Sup. Orb. Ridges.	Lips.	Breasts.	Ear Lobule.	Darwin. Tubercle.	Nose.
Slim	Medium	Thick	—	Free	Absent	—
Plump	Medium	Thick	—	—		—
Medium	Medium	Thick	—	Adherent	Absent	—
Plump	Pronounced	Upper, thin; lower, thick		Adherent	Absent	—
Muscular	Medium	Thick	—	—	—	Perforated septum
Plump	Medium	Thick	Large	—	—	
Lank	Medium	Medium	—	—	—	—
Muscular	Excessive	Thick	—	—	—	—
Slim; adolescent	Medium	Upper, m'dium; lower, thick	Small	—	—	—
Plump; adolescent	Medium	Medium	Medium	—	—	—
Slim	Medium	Medium	Large	—	—	—
Thin	Pronounced	Medium	—	—	—	Perforated septum
Muscular	Pronounced	Medium	—	Free	Absent	—
Medium	Excessive	Thick	—	Adherent	Absent	Perforated septum
Muscular	Pronounced	Thick	—	Adherent	Absent	—
Medium	Pronounced	Thick	—	Adherent	Absent	Perforated septum
Thick set	Pronounced	Thick	—	Adherent	Absent	—
Slim	Excessive	Medium		Free	Absent	—
Slim	Medium	Very thick	Medium	Adherent	Absent	—
Obese	Pronounced	Thick	Large	Adherent	Absent	—
Obese	Pronounced	Medium	—	Adherent	Absent	
Slim	Pronounced	Medium	—	Free	Absent	—
Medium	Excessive	Medium	—	Adherent	Present	—
Muscular	Medium	Thick	—	Adherent	Present	—
Slim	Medium	Medium	—	Adherent	Absent	—
Slim	Pronounced	Thick	—	—	—	
	—	—	—	—	—	—
Slim	Medium	Medium	—	—	—	—

Table V.

Eyebrows.	Hair.		Forearm.		Scars.
	Head.				
Colour.	Character.	Colour.	Amount.	Colour.	
Black	Medium waves	Brown-black	Medium	Black	Nil
Black	Deep waves	Brown-black	Scant	Black	—
Black	Low waves	Brown-black	Medium	Black	—
Black	Low waves	Brown-black	Medium	Black	Chest
Black	Low waves	Brown-black	Medium	Black	Chest, arms
—	Curly	Brown-black	Medium	Black	—
Black	Curly	Brown-black	Medium	Black	Chest
Black	Curly	Brown-black	Medium	Black	Chest, both upper arms
Black	Low waves	Brown-black	Medium	Black	
Yellowish	Medium waves	Dark brown	Medium	Black	—
Black	Deep waves	Black	Medium	Black	—
Black	Deep waves	Brown-black	Medium	Black	Chest, deltoid, antecubital
Black	Deep waves	Brown-black	Medium	Black	Chest, deltoid, forearm, antecubital
Black	Low waves	Black	Medium	Black	Chest, deltoid, antecubital
Black	Low waves	Brown-black	Medium	Black	Chest
Black	Medium waves	Brwn.-black with grey	Spare	White	Chest, both arms
Black	Medium waves	Brown-black	Medium	Black	Nil
Black	Low waves	Dark brown	Sparse	Black	Nil
Light yellowish	Medium to low waves	Dark brown	Medium	Black	—
Black	Deep waves	Dark brown	Medium	Black	Nil
Black	Deep waves	Medium brown	Medium	Black	Chest
Black	Medium waves	Medium brown	Medium	Black	Chest
Black	Deep waves	Dark brwn. with white	Medium	Black	Chest
Black	Curly	Black with grey	Medium	Black with white	Chest, deltoid, abdomen, antecubital
Black	Deep waves	Black	Medium	Black	Chest, cheloid
Black	Curly	Black	Medium	Black	—
—	Deep waves	Dark brown	Scant	Black	—
Light yellowish	Straight	Dirty yellow (flaxen)	—	Dark brown	

R. Pterygium in both eyes. Dark soft sessile mass adherent to mucous membrane of right cheek; not tender.
S. Pulse regular; no thickening of wall of artery. Numerous scars on left knee. Second toe of right foot rudimentary, with no nail. Left little toe, rudimentary. Left second toe, no nail. Extensor tendons of second, third, fourth, and fifth toes of left foot contracted (said to be due to burns).
T. Both lenses cloudy. Pulse regular; radial artery not thickened.
U. Both lenses cloudy. Nebula over left pupil.
V. Internal pterygium in both eyes. Pulse regular; good volume and tension. Nose broken.
W. Extensive arcus senilis in each eye. Pulse regular. Scar on upper lip.
X. Left eye blind, owing to large corneal opacity and obliteration of the anterior chamber. Arcus senilis in right eye. Pulse normal.

Teeth.—Notes were made on the teeth, their presence and absence, and the occurrence of dental caries. It is thought advisable, as these matters are of special dental interest, to give an account of the conditions elsewhere, and we hope our dental notes will shortly appear in the Australian Journal of Dentistry.

Psychological and other Observations.

Psychology.—Some psychological observations were also made, chiefly with regard to dreams; but the present writers found that effective work in this direction was impossible unless one had the complete confidence of the natives and a good speaking knowledge of their language. To objective study such as anthropometry and other physical observations, the mental attitude of the native is seldom any serious hindrance; judicious bribery will generally overcome any scruples about being examined, a little patience will correct the faults of over-willingness. But these were fatal obstacles when one asked the native about his dreams; and if one considers in addition his very small English vocabulary, his delight at "pulling the leg" of a white man and his hope of a reward for information, however mendacious, one cannot but suspect all his statements.

With a view to avoiding some of these pitfalls, a start was made at learning the language—some two hundred words and phrases were noted and then tested by repetition; and medical attention to the sick also helped in securing the confidence of the natives.

The present writers are convinced that the needs of anthropological research on our natives, especially in the neglected and important field of their psychology, can best be served by a long stay among them rather than by a series of brief trips or a moving expedition.

It is not desirable to say more at present than that all the natives who admitted to having dreams at all, had had the "inhibition dream"; the occurrence of the other type dreams was variable. A number of natives denied that they ever dream, a statement also made by various natives from the southern parts of the State seen in the Adelaide Hospital.

Photography.—Full face and profile pictures were taken of all the aborigines examined in detail and of several others. Cinematograph pictures were taken of general camp scenes and native life, and also of the details of fire-making, wurlie building, etc. All the photographic records have been placed in the anthropological section of Professor Wood Jones' department, University of Adelaide.

Music.—Some experimental work was done in attempting to record native corroborree songs, and although the machine used was not sufficiently accurate to secure good recording, some interesting results were obtained. The experience

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gained in attempting this line of work was of great value, and will no doubt prove useful for subsequent efforts.

Stone Implements.—A collection was made of small chipped stone implements. The vicinity of the Ooldea soak, although it has received much attention from collectors, still provides sufficient material for interesting work. The types of implements found correspond generally to those found on all camp sites of Central Australian regions.

In the section dealing with psychological observations, we have expressed our views as to the desirable conditions for systematic anthropological work on our natives. Such results as are recorded in this paper are the fruit of only a fortnight's trip; it is our hope that future expeditions will have the opportunity of a longer stay with one group of aborigines. When there are available not only enthusiasm and patience but adequate time and material resources, then much valuable work can be accomplished.

REFERENCES.

1. F. Wood Jones and T. D. Campbell, "Anthropometric and Descriptive Observations on some Australian Aboriginals, with a Summary of previously recorded Anthropometric Data." Trans. Roy. Soc. S. Austr., vol. xlviii., 1924, p. 303.
2. A. Hrdlicka, "Anthropometry," 1920.

DESCRIPTION OF PLATES XXX. to XXXII.

Plate XXX.

Full face and profile photographs of (from left to right) subjects P, O, E, and Q.

Plate XXXI.

Full face and profile photographs of (from left to right) subjects V, U, T, and F.

Plate XXXII.

Full face and profile photographs of (from left to right) subjects S, A A, and two young boys not included in the tables; their names are Lawrence and Alec, their ages four and five years, respectively.

THE WOOLTANA BASIC IGNEOUS BELT.

By D. Mawson, D.Sc., F.R.S.

[Read August 12, 1926.]

Plates XXXIII. to XXXV.

In my paper[1] entitled "The Igneous Rocks of the Mount Painter Belt" contributed some three years ago, reference was made to the occurrence of vesicular, basic igneous rocks of a character definitely indicating an effusive origin. These were noted *in situ* on the Bolla Bollana Creek, but the hasty visit to the locality had not sufficed to establish their stratigraphical relations. Other examples, of a still more definite effusive character, were noted in collections made by Mr. W. B. Greenwood from Wooltana Station, further to the east, but the exact locality of the find was wanting.

By good fortune, not long after that paper was published, an opportunity of a visit to Wooltana presented itself, as a result of which an extensive area of similar igneous types of a definitely effusive nature has been located. The main outcrop noted extends in a nearly north and south direction for more than six miles, forming a bold scarp face some hundreds of feet in vertical extent at and immediately west of Wooltana Head Station. These igneous rocks constitute the bulk of the outcrop along the high hill faces which are thereabouts presented to the east and form the eastern limits of that portion of the Flinders Range. Here the ranges composed of very ancient terraines suddenly end, and a low plain, underlain for the most part by Mesozoic and Recent sediments, extends to the east on a gentle down-grade to Lake Frome.

There can be no doubt as to the existence of fault lines defining the limits of the Flinders Range in that area. As a tectonic feature the most striking of these lines of fault is that extending between Paralana Hot Spring and Moolawatana. This appears to be indicated in a sketch section accompanying a recently published article[2] by Dr. W. G. Woolnough.

My inspection of the igneous formation under discussion was limited to a day in the field about two years ago, when making a reconnaissance of the Mount Painter region in company with Messrs. R. G. Thomas, B.Sc., and A. R. Alderman, B.Sc. Therefore the present notes, though establishing certain fundamental aspects relating thereto, are not by any means as extensive as the remarkable occurrence warrants. Specimens were collected at Wadnamoka Well, some four miles to the north of the Wooltana Head Station buildings; also at two miles north, at the Head Station itself, and at about two miles to the south thereof.

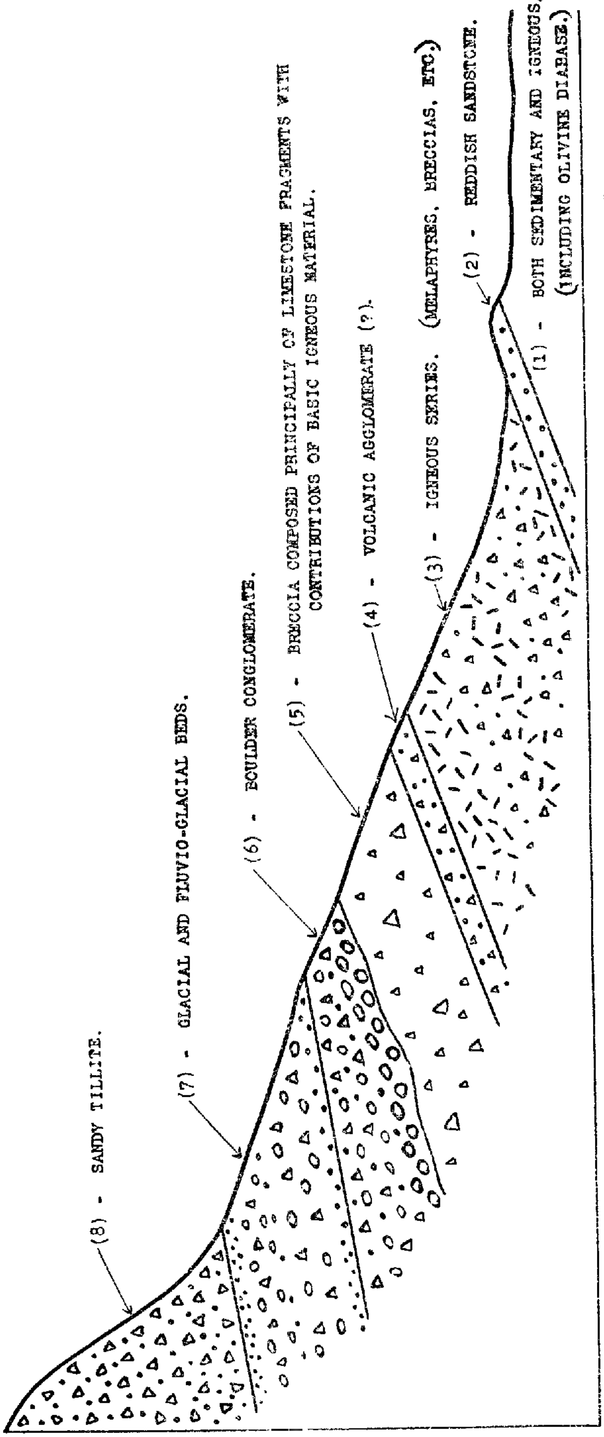
Stratigraphy.

So far as noted the rocks are all of a basic character, ranging in texture from that of coarse dolerite (almost gabbro) to that of hyalopilitic basalts. Many of them have been highly vesicular and have resulted in striking amygdaloidal types. All, on account of their great antiquity, have undergone considerable change, including uralitization, serpentinization, and chloritization. Copper stains were noted on many of the outcrops, indicating that to some extent at least the magma was cupriferous. At about one and a half miles to the south-west of Wooltana

(1) Trans. Roy. Soc. S. Austr., vol. xlvii., p. 376.

(2) "Preliminary Note on the Occurrence of large Erratic Blocks, probably of Glacial Origin, on the Eastern Escarpment of the Flinders Range, South Australia," by W. G. Woolnough, D.Sc., F.G.S., Repts. A.A.A.S., vol. xxvii. (1924), p. 81.

Head Station, there are abandoned mine workings in the igneous rock, evidently made in search of asbestos, for long-bladed forms of semi-asbestos up to 6 inches in length were noted in the dump.



Sketch Section representing the Rocks exposed in portion of the Scarp below Mount Jacob, Flinders Range.

These igneous rocks have intruded and apparently flowed over an older series of sedimentary rocks comprising dolomitic limestone, sandstone, and shale, which in turn are younger than the older components of the highly metamorphic core rocks of the Mount Painter belt. This older sedimentary formation with intrusions of the Wooltana magma is exposed in the foot hills for miles to the north of the station buildings. Above the igneous series are boulder beds with glacial characteristics which form the base of a great sedimentary synclinal basin extending between a point about one mile west of Wooltana Head Station and the Arkaroola Creek to the west of the Mount Warren Hastings.

A sketch section of the beds encountered in a transverse approximately at right angles to the direction of strike at a point about two miles north of the Head Station, actually below Mount Jacob, is included herewith. In this figure an approximation to the contour of the land surface is attempted. From this graphic representation the thickness of the beds may be roughly gauged.

A brief description of the formations encountered successively from the base upwards is as follows:—

1. On the low ground at the foot of the scarp are both sedimentary and igneous formations, the latter clearly intruding the former in some cases. Later in this paper an example of a diabase from this zone is described at length. In this part of the section, as a result of the flatness of the ground thereabouts, the exposures are poor.
2. The first strongly marked feature is a bed about 60 feet in thickness of reddish-coloured sandstone with included wisps of chocolate-coloured shale.
3. Next comes an igneous contribution of considerable thickness, apparently representing lava and ash beds. These are melaphyres of a purple hue and some chocolate shales which are presumed, though not proved, to be transformed ash beds; also coarser tuffaceous beds in which particles of sedimentary and of igneous rocks are commingled. In these latter the somewhat rounded particles of igneous rock are all of altered semi-glassy basic lavas.

   The top member of this section is a lava in which vesicles make their appearance towards the upper limit, increasing in number until the rock is truly scoriaceous. This is situated just below a narrow top band of a dense character which is only a few inches wide, and is taken to represent the original chilled surface of the flow.

   This sheet dips to the north-west at an angle somewhat more than 20 degrees. The aggregate vertical thickness of the whole of this formation is apparently of the order of about 300 feet.
4. A clastic formation of about 30 feet in thickness. It appears likely that this represents an igneous agglomerate, though its character is somewhat masked by secondary changes. It is composed of rock fragments and finer material, the principal contributions being forms of basic igneous lava.
5. Thence follows roughly 225 feet of fragmental beds of a curious type. At the base there is a thin bed, between 2 feet and 3 feet in thickness, of purple gravels and sands, evidently water-sorted. Fluvial conditions were, however, short lived, for the remainder of the formation is composed of an unassorted fragmental rock in which angularity of the fragments is a noticeable feature. Below, the obvious contributions are principally of a basic igneous character, but these lessen rapidly above, whilst ever increasing quantities of fragments of a buff-coloured, dolomitic limestone are presented. Blocks of this latter as much as 3 feet in greatest dimension were actually observed.

In the upper third of this section the fragments, for the most part, range from nothing up to 6 inches in diameter, and are almost all of the dolomitic limestone. But the basaltic rock and a quartzite were also noted in small quantity. These beds partake in some measure both of the characters of a volcanic breccia and of a tillite. Unfortunately the cursory inspection did not suffice to conclusively settle their nature, but the weight of evidence is in favour of a glacial and fluvio-glacial origin.

6. From this point upwards the dip of the beds is distinctly less than of those below.

Here comes in, at the base, a boulder bed packed with rather rounded boulders of basic igneous rock and some quartzite. The thickness is about 15 feet. It is so predominantly igneous that it resembles an igneous agglomerate, but it is more likely to be a basal water-laid conglomerate developed on an older tilted surface. Above this basal boulder rock this section continues as a jumbled pebble bed to a total thickness of 70 feet.

7. Next in the succession comes a thick series of beds, totalling roughly 210 feet, consisting of water-sorted and partly unassorted boulder beds, most probably of fluvio-glacial and glacial origin. At the base is a little water-sorted grit striking N. 50° E. and dipping 10° to the N.W. This passes up into coarse fragmental beds containing large boulders, obvious amongst which are a pink granite, and a quartz porphyry similar to types occurring *in situ* near Mount Painter. Fragments of basic igneous rocks are scarce, so that, in this formation, there is a notable change from the preceding.

As the top is approached the pebbles become smaller and a little water-sorted grit appears. Then the nature of the bed again relapses to an unassorted boulder-bearing type. Finally the last feature, of a thickness of 14 feet, is a quartzite rock evidencing fluvial activity.

8. This section appears to be of a definitely glacial and fluvio-glacial nature. Resting upon the last-mentioned quartzite is a thick mass of what, by its petrological characteristics, can be nothing else than a sandy tillite. Time did not permit of extending the traverse beyond the lower portion, but the outcrops on the hill face ahead left it fairly certain that the tillite continued for at least a further 420 feet in thickness.

The base of this rock is of a friable sandy nature. Through it pebbles and boulders are strewn ranging up to almost 3 feet in diameter. In the lower part, the pebbles are almost entirely of a coarse pebbly and gritty quartzite showing current bedding. In appearance the quartzite of the boulders is quite like that of a great quartzite formation met with in Radium East Creek, a few miles to the north. The general appearance of the rock at this point is indeed very like certain sandy tillite of Permo-carboniferous age occurring at Bacchus Marsh, in Victoria. In this case, however, a faint purple tone pervades the rock.

Somewhat higher up, granite boulders make their appearance. These pebbles all exhibit subdued rounding and faceting, but no actual glacial striae were noted. There was, however, no doubt in my mind at the time as to the glacial nature of these beds, for no other explanation appeared adequate to produce such an association of fine silt and large boulders.

It was unfortunate that time did not permit of the extension to the west of that particular section. However, absence of such data

as would have been forthcoming was in large measure supplied from observations made the following day, whilst journeying from east to west across the strike of the country at a point somewhat further to the south. This happened on a route-march from Wooltana Head Station to McLeache's Well.

Travelling west along this line, the extension of the above formation is again traversed in ascending succession, but the detail exposed is comparatively limited. First comes the igneous rock, interstratified with, or intruded into sedimentary beds. Then follow boulder beds of a distinctive tillite-like character, evidently representing the upper beds of the former section. In the upper portions, porphyry erratics of several types are extremely abundant. Above the glacial beds come laminated slates of the Tapley's Hill type, though somewhat of a lighter grey colour than those of the classic locality. The presence of such laminated beds is important additional evidence indicative of a glacial origin for the boulder beds.

The slates become more and more calcareous, culminating in dolomitic limestone, of which there is a great development. The features of this sedimentary basin are all in accord with the presumption that they correspond to the Sturtian tillite and overlying horizons. The limestones were searched for fossil evidence, but yielded only indefinite traces such as are featured in the Brighton limestones. As these beds are not severely altered, it is thought that, were they of Cambrian or later age, a fossil record would be preserved.

Such evidence as it is, therefore, indicates the age of the overlying sediments to be the same as that of the upper beds of the Adelaide Series, namely, late Proterozoic. Obviously the underlying igneous horizon either preceded the glacial period or was contemporaneous with it. If preceding it, the probability is that no considerable erosion interval separated the volcanic period from the ice age, else the bulky accumulation of volcanic material would have been removed prior to the advent of the glacial cycle.

Petrological Descriptions.

The leading types of the igneous rocks encountered are included in the following descriptions:—

Amygdaloidal Melaphyres.

In these originally vesicular lavas, the steamholes are entirely choked by secondary minerals of a white or pink colour. The rocks range in colour through purple, reddish-brown, to grey, and are often highly vesicular, even to the extent of there being more vesicles than lava. In micro-section the rock is seen to vary from a fine-grained, holocrystalline basalt of pilotaxitic texture, to hyalopilitic varieties in which almost hair-like laths of plagioclase are scattered through what was originally a glassy base.

The antiquity of these lavas is reflected in the advanced state of alterations exhibited. For example, original glass is entirely converted to a dense, more or less opaque dusty aggregate. Pyroxene is, for the most part, uralitized in the basaltic lavas. Felspar laths are now aggregates of tiny secondary particles, which change has, in most cases, obliterated the albite twin lamellae. Both in the case of the glass and of the ferromagnesian minerals, a notable accompaniment of these changes has been the liberation of iron oxide. This may appear in the form of distinct grains or as the finest dust distributed through the resulting paramorphs. Magnetite is abundant, but haematite as fine dust and stains is also generally present. It is due to the development of this ferric anhydride that the

rocks frequently assume red and purple hues. Chlorite and serpentine both figure amongst the alteration products. Also minute grains of epidote and occasional particles of calcite are of general occurrence.

The vesicles may be all beautifully spherical or ellipsoidal or tortuous. The more frequent type of steamhole fillings consists of an outer zone of a reddish-coloured, zeolitic mineral, followed by a central filling of calcite. In the microscope slide occasional grains of quartz may be discovered embedded in the calcite, also between the calcite and the pink mineral a small development of a fine scaly mineral, apparently sericite, may appear. The pink mineral corresponds closely with stilbite in its optical properties and hardness, and is, therefore, taken to be that mineral.

Melaphyre

occurring *in situ* at Woodnamoka Well. This is representative of dense non-amygdaloidal basaltic forms.

In the hand specimen, the rock is of fine even grain and of a purple colour.

Microscopically examined, it is evident that it was originally a fine-grained, but in all probability a completely crystallised, basalt. The average grain size is about 0·12 mm. The arrangement of the plagioclase laths is intersertal. There is a tendency to ophitic structure on a small scale.

The plagioclase laths are so changed that no determinations of extinction angles are possible. The alteration products of the felspars include chlorite and very fine dust-like grains of epidote. Minute particles of a mineral of low double refraction may be spongy secondary albite.

Former granular pyroxene appears as faintly greyish-brown remnants. These are constituted of secondary actinolite, microscopic particles of epidote, some chlorite, and possibly some serpentine.

Magnetite and ilmenite are present in moderate quantities, the latter exhibiting the change to leucoxene. Certain yellowish-grey granules appear to be sphene, probably arising out of ilmenite. Haematite flakes and stains pervade the section. Calcite is clearly noticeable as fillings of veins and cavities and in scattered particles.

Chemical Analysis.

Analyst: W. S. Chapman.

	Per cent.
SiO_2 (Silica)	48·46
Al_2O_3 (Alumina)	18·76
Fe_2O_3 (Ferric oxide) ..	6·38
FeO (Ferrous oxide) ..	3·01
MgO (Magnesia)	6·94
CaO (Lime)	5·00
Na_2O (Soda)	3·44
K_2O (Potash)	1·89
H_2O (Water over 100° C.)	3·55
H_2O (Water at 100° C.) ..	·01
CO_2 (Carbon dioxide) ..	·26
TiO_2 (Titanic dioxide) ..	1·53
P_2O_5 (Phosphoric anhydride)	·28
SO_3 (Sulphur trioxide) ..	nil
Cl (Chlorine)	nil
FeS_2 (Ferric disulphide) ..	·04
Cr_2O_3 (Chromium sesquioxide)	nil
MnO (Manganous oxide)	·08
BaO (Barium oxide) ..	·05
Total ..	99·68

Composition of the Norm.

	Per cent.
Quartz	1·02
Orthoclase	11·12
Albite	28·82
Anorthite	23·35
Corundum	2·55
Hypersthene	17·30
Magnetite	5·57
Ilmenite	2·89
Haematite	2·56
Pyrite	0·04
Apatite	0·67
CO_2 and H_2O	3·82
Total ..	99·71

C.I.P.W. Classification: Class II., Order 3, Rang III., Sub-rang 4.

Types rather similar to this form part of the igneous contribution in the section traversed below Mount Jacob. In that locality they may appear as evenly purple in colour or exhibit greenish-grey mottlings on a purple background. In some cases there is fairly definite evidence of glass in the original rock. Others contain abundant relics of olivine. Chlorite and calcite are the more obvious and general secondary products.

Amongst specimens collected from detrital material in the creek bed at Wooltana Head Station, and evidently descended from the hills to the west, is a rock, originally very similar to this melaphyre from Woodnamoka Well, but now very largely converted to yellow-green epidote.

Olivine Diabase: Woodnamoka Well.

In the hand specimen this appears as a fine, crystalline, dark-grey rock.

Microscopically examined, it is seen structurally to represent an intermediate stage between basalt and dolerite. Lath-shaped plagioclases are arranged in a meshwork in which there is some slight preferential orientation, indicating feeble flow movement during the early stages of crystallization.

Plagioclase is abundant, commonly in individuals of 1 mm. in length. Though largely broken down to minutely scaly paramorphous aggregates, indications of the albite twin lamellae still remain, but not of a determinative quality. The change in the felspar has been towards the production of chlorite, quartz, and possibly albite, but a little very fine granular epidote also appears in some cases.

Original pyroxene occupying the interspaces amongst the felspars has changed to pale actinolite fibres, dust-like epidote, and some chloritic or serpentinous product. In some cases, there appear scraps and wisps of what are taken for bleached remnants of the original mineral.

Olivine in very small quantity has been present, and in odd cases residual unchanged mineral still remains. The alteration has been to serpentine and iron ores.

Calcite is very noticeable either as a narrow border zone around scattered patches of chlorite or as particles distributed amongst other alteration products.

Magnetite appears as equant granules of noticeably small dimensions, from which ilmenite can be distinguished by its development in elongated forms and by its partial change to leucoxene. Haematite is abundant either in association with the magnetite or as scattered stains. Some tiny, highly refracting, yellowish grains adjacent to ilmenite individuals suggest secondary sphene rather than epidote.

Chemical Analysis.

Analyst: A. R. Alderman, B.Sc.

	Per cent.
SiO_2 (Silica)	47·75
Al_2O_3 (Alumina)	12·77
Fe_2O_3 (Ferric oxide) ..	7·22
FeO (Ferrous oxide) ..	4·38
MgO (Magnesia)	9·92
CaO (Lime)	5·79
Na_2O (Soda)	3·46
K_2O (Potash)	0·81
H_2O (above 100° C.) ..	3·38
H_2O (at 100° C.)	0·43
CO_2 (Carbon dioxide) ..	1·98
TiO_2 (Titania)	1·65
P_2O_5 (Phosphoric pentoxide)	0·19
MnO (Manganous oxide)	0·28
Total ..	100·19

Composition of the Norm.

	Per cent.
Orthoclase	5·00
Albite	29·87
Anorthite	16·68
Diopside	8·42
Hypersthene	19·50
Olivine	0·98
Magnetite	10·44
Ilmenite	3·04
Apatite	0·67
H_2O and CO_2	5·79
Total ..	100·39

C.I.P.W. Classification: Class III., Order 5, Rang III., Sub-rang 4.

Ophitic Olivine Diabase.

This occurs as a dyke or sheet on flat ground about 250 yards west of the mail track to Parallana Station, some two miles north of Wooltana Head Station.

In the hand specimen this rock is grey coloured with a faintly greenish tone and exhibits somewhat of a serpentinous appearance.

Under the microscope it is seen to be of a coarser grain than any of the preceding. There is also a larger proportion of ferromagnesian minerals. The plagioclase is in stouter individuals, but exhibits a rectangular form, not the granular habit typical of the gabbros. There is a broad-scale development of intersertal structure and excellent ophitic intergrowth of augite and felspar. The structure of the rock is, therefore, coarse doleritic, and as the minerals have all suffered age changes, the term ophitic diabase is most appropriate. In addition to felspar, the original rock contained abundant pyroxene and a notable quantity of olivine.

The felspars show very slight evidence of former albite twinning. They have been transformed more or less completely to aggregates, in which appear elements with optical properties apparently corresponding with the following: veins and flecks of chlorite, minute grains of epidote, sericitic mica in small amount, and particles with a refractive index about that of mizzonite which, however, may be residual felspar material.

The augite still remains in part as a transparent mineral of a warm faintly-pink colour and high extinction angle. Unaltered ophitic individuals as much as 3 mm. in length are abundant. In other cases the pyroxene is dusty in appearance, due either to incipient or complete change to uralitic amphibole, or to fine dust-like epidote, and in places to serpentinous products.

The olivines are represented by relics in the form of faintly-green aggregates of serpentine associated with iron ores. The latter are partly magnetite, but chiefly haematite, which has separated out in quantity around the periphery and along cracks in the original mineral. The average diameter of the former olivines is of the order of 0·5 mm.

Scattered irregularly at intervals throughout the section, are small distinct granules of yellow epidote, ilmenite considerably converted to leucoxene, magnetite, also both stains and patches of haematite. There is a general pervasion of serpentine. Calcite is practically absent, though noted in very small amount in one place.

The order of crystallization of the original minerals appears to have been ilmenite and magnetite, olivine, felspar, then pyroxene.

Chemical Analysis.

Analyst: A. R. Alderman, B.Sc.

	Per cent.
SiO_2 (Silica)	45·52
Al_2O_3 (Alumina)	14·39
Fe_2O_3 (Ferric oxide)	5·21
FeO (Ferrous oxide)	6·79
MgO (Magnesia)	12·68
CaO (Lime)	6·22
Na_2O (Soda)	1·68
K_2O (Potash)	1·38
H_2O (above 100° C.)	3·91
H_2O (at 100° C.)	0·88
CO_2 (Carbon dioxide)	nil
TiO_2 (Titania)	1·46
P_2O_5 (Phosphoric pentoxide)	0·13
MnO (Manganous oxide)	0·22
Total	100·47

Composition of the Norm.

	Per cent.
Orthoclase	7·78
Albite	14·15
Anorthite	27·80
Diopside	1·79
Hypersthene	24·63
Olivine	8·74
Magnetite	7·66
Ilmenite	2·74
Apatite	0·34
Water	4.79
Total	100·42

C.I.P.W. Classification: Class III., Order 5, Rang IV., Sub-rang 2.

A further specimen collected at Woodnamoka Well illustrates what was a very similar type of rock somewhat differently affected. There the plagioclases are saussuritized; both zoizite and epidote appear in the products. In the pyroxene, much serpentine and epidote appear.

Summary.

At Wooltana, on the eastern escarpment of the Flinders Range, near its northern extremity, is an extensive outcrop of both effusive and intrusive basic igneous rocks, including amygdaloidal melaphyres and olivine diabases. The igneous rocks are closely associated with the ancient tillite horizon which, by its field relation, is thought to correspond with the Sturtian (late Proterozoic) tillite. The volcanic activity was either contemporaneous with the glaciation or preceded it with no great intervening time break.

Among the igneous rocks from Wooltana are many that exhibited considerable similarity to those described by Professor Howchin as occurring at Blinman, 67 miles to the south-west. These latter are, however, reported to be all intrusive, and their field relations, so far as at present known, indicate a late Cambrian or post-Cambrian age. But as there is yet little known of the stratigraphy of that region, there may be a closer correspondence in time of intrusion than is at present apparent.

In conclusion, I have to thank Messrs. W. S. Chapman and A. R. Alderman for furnishing the analyses quoted. Also my thanks are due to Mr. L. Keith Ward (Government Geologist), who, through the Mines Department, arranged for the execution of the former analysis.

DESCRIPTION OF PLATES XXXIII. to XXXV.

Plate XXXIII.

Photograph of the eastern scarp of the Flinders Range as seen looking to the west-north-west, one-third mile north of Wooltana Head Station. Mount Jacob is the highest point in the view, featured on the sky-line near the centre of the picture.

Plate XXXIV.

Fig. 1. A polished face of amygdaloidal melaphyre from vicinity of Wooltana Head Station. In this case the vesicles are unusually spherical. The rock is dark grey in colour with white vesicles. Photo. natural size.

Fig. 2. Polished face of an amygdaloidal melaphyre from near Wooltana Head Station. A purple-coloured rock with irregular shaped vesicles occupied by white and salmon-coloured fillings, principally quartz and zeolite. Photo. natural size.

Plate XXXV.

Fig. 1. Devitrified amygdaloidal melaphyre, from the vicinity of Wooltana Head Station. A deeply pigmented glassy base through which are scattered tiny hair-like plagioclases. The glassy base has largely broken down to minute particles of a secondary nature, but is so much pigmented by microscopic granules of iron oxide as to be almost opaque. The vesicles are occupied by quartz, calcite, and a little chlorite. Magnification ×30 diameters.

Fig. 2. A melaphyre from vicinity of Wooltana Head Station. A strong devitrified base rendered opaque by abundance of finely disseminated iron oxide. Plagioclase laths. Magnification ×60 diameters.

Fig. 3. Diabase from Woodnamoka Well. Plagioclase laths, somewhat frayed by secondary alterations, form a general mesh-work with some tendency to parallel arrangement. In the interstices between the relic felspars are the products of alteration of the ferro-magnesian constituents. Magnification ×20 diameters.

Fig. 4. Olivine diabase from an intrusion two miles north of Wooltana Head Station, 250 yards west of the mail track to Paralana. Note the abundant remains of granular olivine, much of it rendered opaque by depositions of secondary iron oxides. The remainder of the plate is occupied by secondary aggregates after felspar and augite. Magnification ×20 diameters.

The Eastern Scarp of the Flinders Range at Wooltana showing Igneous Formation in the summit view and Glacial and Fluvio-glacial Beds in the distant range.

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Fig. 1.

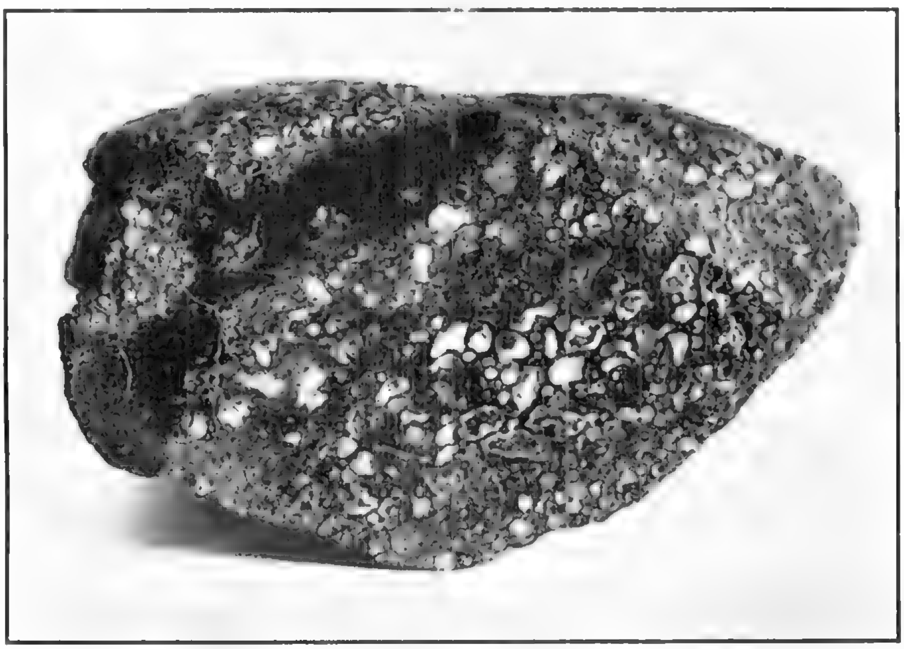

Fig. 2.

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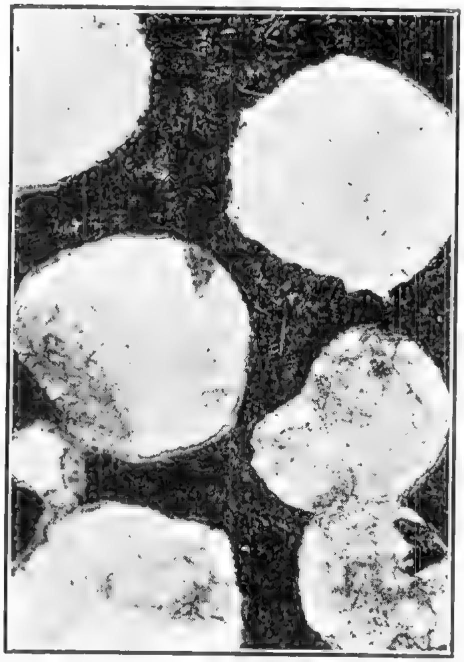

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

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REVIEW OF AUSTRALIAN ISOPODS OF THE CYMOTHOID GROUP.

Part II.[1]

By Herbert M. Hale, Zoologist (Crustacea), South Australian Museum.
(Contribution from the South Australian Museum.)

[Read August 12, 1926.]

Plates XXXVI. and XXXVII.

Family CYMOTHOIDAE.

The representatives of this family, when adult, are distinguished by the following characters:—Antennae short, not clearly divided into peduncle and flagellum. Mandibles with stout, three-jointed palp. First maxillae styliform, with a few apical spines. Apex of second maxillae bilobed. Palp of maxilliped two-jointed, the terminal article as a rule furnished with hooked spines. Pleopods, uropods, and telson rarely with any trace of marginal hairs. Peraeopods prehensile, terminating in curved (and usually strong) dactyli.

All the species are parasites, and in the adult state some are variable in form, the body being asymmetrical, twisted, or distorted. At least seven of the genera are represented off Australian coasts; the keys to the Australian genera and species refer to adult specimens.

In dealing with this family I wish to express thanks to Dr. K. H. Barnard, of the South African Museum, and to Mr. F. A. McNeill, of the Australian Museum, for assistance with literature not available in Adelaide libraries.

Key to Australian Genera.

a. Pleon composed of six distinct segments. Exopod of first pair of pleopods soft, not curved over sides of pleon.
  b. Cephalon not at all immersed in first peraeon segment, with posterior margin trilobate. Anterior margin of first peraeon segment trisinuate.
    c. Peraeon relaxed and usually flattened; posterior angles of hinder segments often prominently produced; all coxal plates large and prominent .. .. *Nerocila*
    cc. Peraeon compact; posterior angles of hinder segments never produced; coxal plates of fourth to seventh segments small .. *Anilocra*
  bb. Cephalon more or less immersed in first peraeon segment, with posterior margin not trilobate. Anterior margin of first peraeon segment not trisinuate.
    d. Antennae somewhat compressed, not at all dilated, the bases of the first pair widely separated.
      e. Pleon abruptly narrower than peraeon .. .. *Cymothoa*
      ee. Pleon not abruptly narrower than peraeon.
        f. Pleon rarely strongly immersed in peraeon. Carina of basos of posterior peraeopods more or less prominent. Upper lip not prominently projecting .. .. *Livoneca*
        ff. Pleon usually strongly immersed in peraeon. Carina of basos of posterior peraeopods obsolete. Upper lip prominently projecting .. .. *Irona*
    dd. Antennae considerably dilated, the first pair contiguous at base *Codonophilus*
aa. Pleon segments fused together. Exopod of first pair of pleopods hard, curved over sides of pleon .. .. *Ouroscuktes*

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(1) Part I., Trans. Roy. Soc. S. Austr., xlix., 1925, pp. 128-185, figs. 1-28.

Nerocila, Leach.

Nerocila, Leach, Dict. Sci. Nat., xii., 1818, p. 351; Sch. and Mein., Naturh. Tidsskr., (3) xiii., 1881, p. 4; Stebbing, S. Afr. Crust., ii., 1902, p. 55 (syn.); Rich., Bull. U.S. Nat. Mus., liv., 1905, p. 219.

Pterisopodus, Boone, Proc. U.S. Nat. Mus., liv., 1918, p. 219.

The posterior margin of the cephalon is prominently trilobate, and the anterior margin of the first peraeon segment is correspondingly trisinuate. The peraeon is depressed and somewhat relaxed and all the coxal plates are large and prominent.

It is known that in the Cymothoidae, protandrous hermaphroditism occurs in at least four genera, one of which is *Nerocila*. Calman[2] remarks that "In certain Cymothoinae the external characters of the male sex do not completely disappear when the individual passes into the female phase, the copulatory appendage of the second pleopods sometimes remaining of conspicuous size even in specimens which have the marsupium filled with eggs." In fig. 1, *e*, *f*, and *g* are

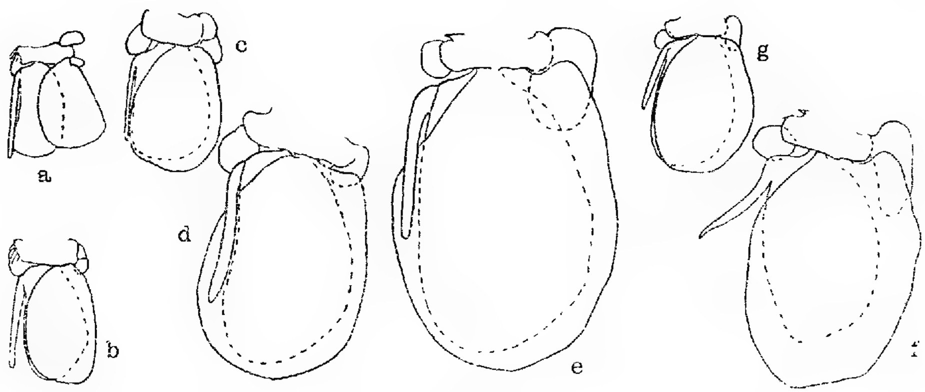

Fig. 1.

a to *e*, Second pleopods of five specimens of *Nerocila macleayii*, respectively 17 mm., 18·5 mm., 21 mm., 26 mm., and 33 mm. in length, showing diminution in relative length of male appendage as the animal grows; the pleopod at *e* is that of an ovigerous female, but the male appendage is persistent; *f* and *g*, second pleopods of ovigerous females of *N. laticauda* and *N. serra*, with male appendage (all 5 diam.).

drawings of the second pleopod of an ovigerous female of each of the species of *Nerocila* occurring in Australian waters; the examples from which the organs were taken have a well-developed brood pouch crammed with either eggs or young, but, nevertheless, the "appendix masculina" is retained. An examination of some two score specimens of *N. macleayii* and *N. laticauda* indicates that the male appendage of the second pleopods is long in the young and steadily diminishes in relative size as the animals grow, and that it is commonly retained, in a thin and abbreviated form, in the ovigerous females of these species. Thus, in a specimen of *N. macleayii* 17 mm. in length the appendage is longer than the endopod, in an example 18·5 mm. in length it is a little shorter than the endopod, and so on, until in the adult female it is not much more than one-half as long as the endopod (fig. 1, *a* to *e*).

[2] Calman, Lankester's Treatise on Zool. (Crust.), 1909, p. 213.

Key to Australian Species.

a. Coxal plates of seventh peraeon segment not reaching back beyond posterior angles of that segment. Edges of endopod of uropoda not serrate.

b. Uropoda not or scarcely extending beyond apex of telson, with endopod sub-oval and apically rounded .. .. *laticauda*

bb. Uropoda extending beyond apex of telson, with apex of endopod acute.

c. Postero-lateral angles of second and third peraeon segments not backwardly produced; endopod of uropoda with intero-posterior margin very obliquely truncate and sometimes slightly concave *macleayii*

cc. Postero-lateral angles of second and third peraeon segments backwardly produced; endopod of uropods with inner margin slightly curved and outer margin somewhat sigmoidal .. *australasiae*

aa. Coxal plates of seventh segment reaching back beyond posterior angles of that segment; edges of endopod of uropoda conspicuously serrate .. .. *serra*

As will be seen from the illustrations the maxilliped is very similar in the three species examined, the organs only differing in relative width, commensurate with the form of the animal concerned; the maxillae also are apparently of little specific value.

Nerocila laticauda, Schioedte and Meinert.

Nerocila blainvillei, Sch. and Mein., Naturh. Tidsskr., xiii., 1881, p. 78, pl. vi., figs. 11, 12 (*nec* M. Edwards).

Nerocila laticauda, Sch. and Mein., *loc. cit.*, p. 81, pl. vi., figs. 14, 15; Whitel., Mem. Austr. Mus., iv., 1901, p. 235.

♀. Ovigerous. Surface smooth or almost smooth, with a very few scattered punctures. Cephalon subquadrate, a little wider than medianly long; eyes very obscure. First antennae a little shorter than second and composed of eight articles; second antennae reaching back to level of hinder margin of cephalon, composed of nine articles. First article of palp of mandibles stouter and not much longer than second, which is longer than the third article. Peraeon widest at fifth segment; medial length of first segment a little greater than that of second to fourth segments, and subequal to that of fifth to seventh segments; postero-lateral portions of all segments produced outwards and backwards, those of the last three segments very prominently produced, in the seventh segment reaching back to beyond level of hinder margin of fifth pleon segment. Coxal plates almost wholly concealed by expanded lateral parts of peraeon segments in dorsal view, only a tiny portion of the first two pairs being visible; all strongly carinate; the plates of the second segment do not nearly reach to the postero-lateral angles of the segment and the next pair reach to the middle of the length of the lateral margin of their segment; those of the fourth segment scarcely extend beyond level of posterior angle of the third segment, those of the fifth and sixth reach a little beyond level of the posterior angles of the fourth and fifth segments, while those of the seventh segment do not attain the level of the posterior angles of the sixth segment. First five segments of pleon subequal in length and width, medianly tumid, and with pleural portions somewhat produced; telsonic segment subquadrate, about one-third wider than medianly long. Uropods not quite reaching to hinder margin of telson; with both rami suboval, the exopod longer and wider than the endopod. Peraeopods stout and strong, slightly increasing in length backwards.

Colour during life: Dorsum dark olivaceous, with lateral portions of head, a diffused stripe on each side of mid-line of peraeon and pleon, and lateral margins of peraeon and pleon, whitish. Underside whitish, with the outer face of each coxal plate and the outer half of the exopod of the first pair of pleopods, sooty.

Length, 32 mm.

Loc.—South Australia: Kingston, S.E. Coast, and Port Willunga, from *Raja australis* (S. Austr. Mus. Coll.). Western Australia: Albany (W. Austr. Mus. Coll.). Victoria: Port Phillip (J. B. Wilson). New South Wales: Off Botany Bay, 50-52 faths.; off Wata Mooli, 70-78 faths.; off Cape Three Points, 41-50 faths.; and off Jibbon, 50-66 faths. ("Thetis" Exped.). La Perouse, Botany Bay (J. D. Ogilby), Port Jackson (Austr. Mus. Coll.).

Hab.—Western, Southern, and Eastern Australia.

There is considerable variation in the series of adult specimens of this species which is before me. In the example shown at *a* in fig. 2 (a male 23 mm. in length), the lateral parts of the last three peraeon segments are more expanded and backwardly produced, and the pleural parts of the first five pleon segments are much more prominent than in the female at *i*. The peraeon segments are not at all expanded in very young articles, and, generally, the form of small

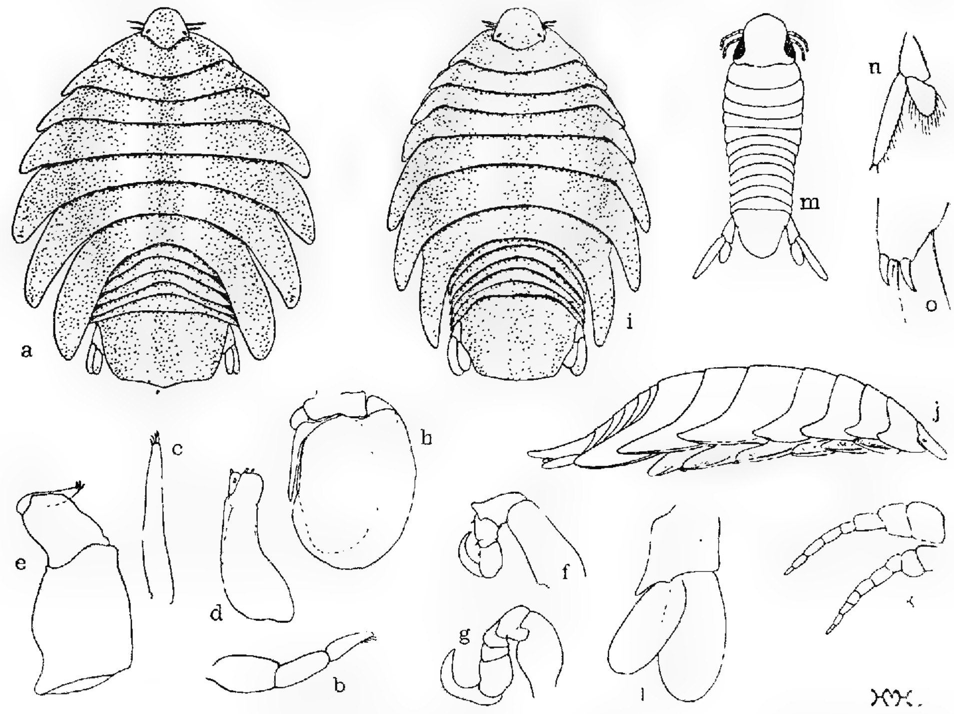

Fig. 2.

Nerocila laticauda. Adult male phase: *a*, dorsal view (2½ diam.); *b*, palp of mandible (19 diam.); *c* and *d*, first and second maxillae (19 diam.); *e*, maxilliped (19 diam.); *f* and *g*, first and seventh peraeopods (5 diam.); *h*, second pleopod (4 diam.). Ovigerous female: *i* and *j*, dorsal and lateral views (1½ diam.); *k*, antennae (6 diam.); *l*, uropod (5 diam.). Juvenile from marsupium: *m*, dorsal view (11 diam.); *n*, uropod (19 diam.); *o*, apex of exopod of uropod (95 diam.).

specimens is narrower than in the adult. The extent to which the segments are produced is, however, by no means constant, and a few small specimens have the lateral parts of the peraeon segments much more expanded than in some of the large ovigerous females. In the last-named the sides of the segments are occasionally scarcely at all expanded (so that all the coxal plates are visible in dorsal view) and the postero-lateral angles of only the sixth and seventh segments are backwardly produced (fig. 3, *c*). Intermediate forms between this and the greatly widened variety occur in other of the adults. The telsonic segment is somewhat

variable in shape, and may be subquadrate or even obscurely subcordate; the posterior margin is usually gently convex or sinuate, but is occasionally concave.

The salient features of the adult are as follows: The lateral parts of the last peraeon segment are always more or less widely expanded, and are produced backwards to at least the level of the posterior angles of the third pleon segment —usually they extend further back than this; the lateral parts of the other segments are generally more or less expanded and produced backwards. The apex of each of the last pair of coxal plates, at most, scarcely reaches past the middle of the length of the lateral margin of the seventh segment. The branches of the uropoda are, as a rule, both suboval (sometimes the exopod is acutely rounded apically), and do not reach much beyond the posterior margin of the telson.

In young examples taken from the marsupium of the mother the cephalon is relatively much larger than in the adult, and the eyes are large. None of the segments of the peraeon or pleon is backwardly produced or laterally expanded. The uropods are of interest in that they differ somewhat considerably from those of the adult. The suboval endopod is scarcely one-half as long, and is one-half as wide again, as the lanceolate exopod; the posterior half of the margins of the endopod, and the inner margin of the exopod, are furnished with hairs, and

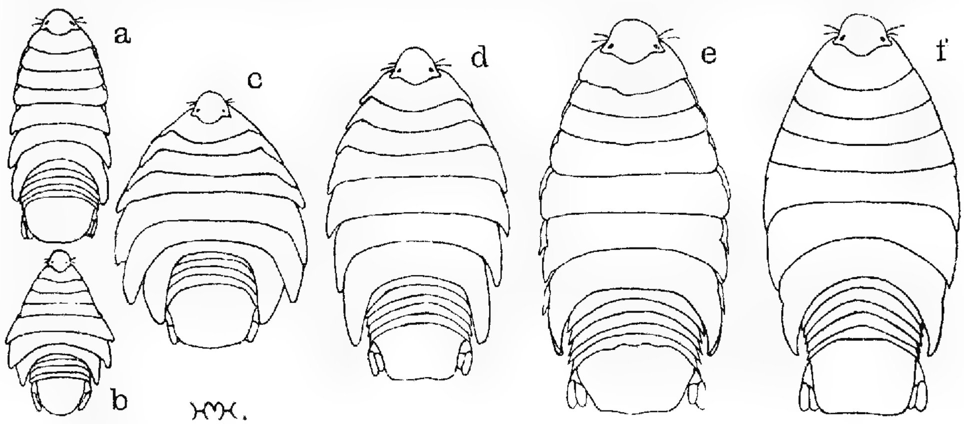

Fig. 3.
Variation in form of *Nerocila laticauda*: *d*, *e*, and *f* are outlines of ovigerous females (all 2 diam.).

the apex of the exopod bears two strong spines. The colour is whitish with the whole dorsum, excepting the telson, dotted with brown chromatophores, which are larger on the cephalon than on the peraeon or pleon. The example figured at *m*, fig. 2, is 3·14 mm. in length, and was taken from the pouch of a female of the form shown at *i*.

Examples only 10 mm. or so in length have the characteristic colour markings as described for the adult, the dark parts consisting of a great number of closely massed chromatophores. In specimens of this size the eyes are tiny, the exopod of the uropods is subacute apically, is much longer than the endopod, and reaches beyond the level of the obtusely angular apex of the telson.

The specimens referred to "*Nerocila blainvillei*" by Schioedte and Meinert were taken "ad Adelaide, Novae-Hollandiae," but, as shown above, the two forms considered by these authors to be distinct species are connected by intermediate varieties. Milne Edwards' description indicates that *N. blainvillei* is an entirely different species, for this author remarks (3): "Espèce très-voisine de la

(3) M. Edw., Hist. Nat. Crust., iii., 1840, p. 252.

précédente, [*N. bivittata*] mais ayant les angles du tergum des anneaux plus pointus, les épimères plus allongés *(les deux dernières paires dépassant de beaucoup les angles du tergum correspondans).* . . . Patrie inconnue."

In *N. laticauda* the posterior coxal plates do not nearly reach to the posterior angle of their segment. The coxal plates of *N. bivittata*, as shown in the figures of Schioedte and Meinert (4) are much longer than those of the specimen figured by the same authors as *N. blainvillei.*

NEROCILA MACLEAYII, White.

Nerocila macleayii, White, in Dieffenb. Voy. N. Zeal., ii., 1843, p. 268; Miers, Rep. Zool., "Alert," 1884, p. 301; Chilton, Trans. N. Z'd. Inst., xxiii., 1891, p. 68, pl. xi.

Nerocila imbricata, Miers, Cat. Crust. N. Z'd., 1876, p. 107.

Nerocila novae-zealandiae, Sch. and Mein., Naturh. Tidsskr., (3) xiii., 1881, p. 70, pl. v., figs. 10, 11.

♀. Ovigerous. Surface glabrous, with a very few scattered punctures. Cephalon rounded, with posterior margin very distinctly trilobate; much wider

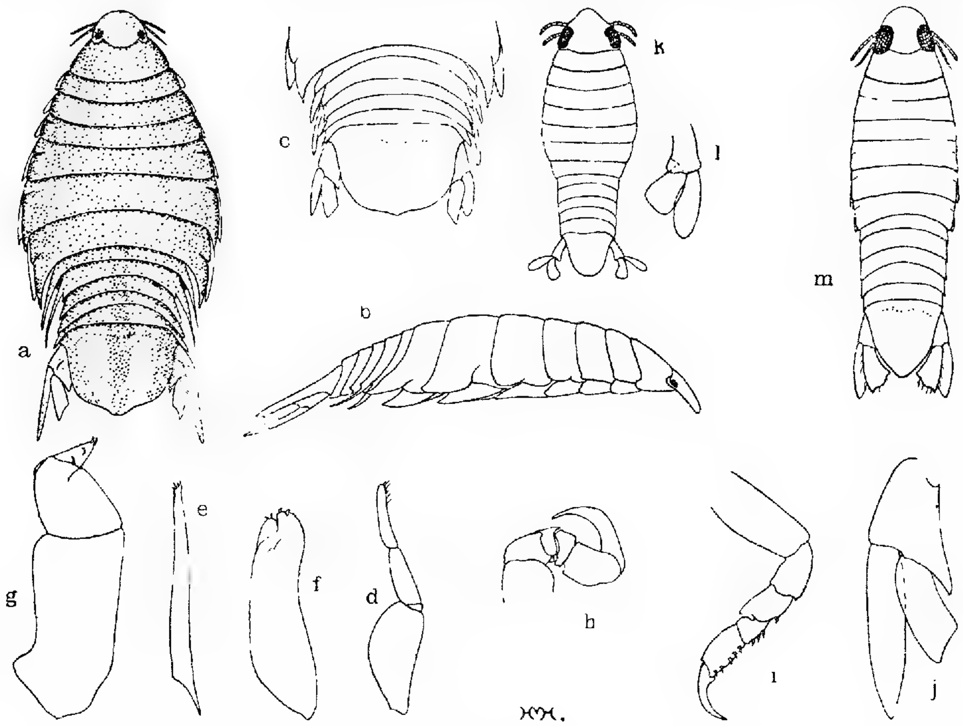

Fig. 4.

Nerocila macleayii. Ovigerous female: *a* and *b*, dorsal and lateral views (1¾ diam.); *c*, pleon of another example (1¾ diam.); *d*, palp of mandible (19 diam.); *e* and *f*, first and second maxillae (19 diam.); *g*, maxilliped (19 diam.); *h* and *i*, first and seventh peraeopods (5 diam.); *j*, uropod (5 diam.). Juvenile from marsupium: *k*, dorsal view (10 diam.); *l*, uropod (29 diam.). *m*, Immature example, 17 mm. in length (3 diam.).

than medianly long; eyes small but distinct. First antennae stouter and a little shorter than second, composed of six articles; second antennae reaching back to middle of length of first peraeon segment and composed of eight articles. First article of palp of mandibles stouter and more than half as long again as

(4) Sch. and Mein., Naturh. Tidsskr., (3) xiii., 1881, pl. iv., figs. 1-15.

second, which is scarcely longer than the third article. Peraeon widest at fifth and sixth segments; medial length of first segment distinctly greater than that of second, third, or fourth segment and subequal to that of fifth, sixth, or seventh segment; postero-lateral parts of sixth and seventh segments backwardly produced in a narrow process with acute posterior angles; posterior angle of first segment very slightly produced backwards. All coxal plates more or less visible in dorsal view; last three pairs obtusely carinate and with posterior angles acute; plates of second to fifth segments reaching to or a little beyond posterior angle of their segments, those of sixth and seventh segments not nearly attaining level of posterior angles of their segments. First five segments of pleon subequal in length; pleural portions of first and second segments produced into narrow, flat processes, those of the second segment reaching back to level of posterior angles of fifth segment; telsonic segment subcordate, wider than long. Endopod of uropods reaching slightly beyond level of apex of telson, wider and much shorter than the exopod, with lateral margins subparallel and with inner posterior margin very obliquely truncate, so that the apex of the ramus is acute. Peraeopods moderately stout, successively increasing in length; seventh pair with one spine on inner margin of merus, three on inner margin of carpus, and four or five on inner margin of propodus.

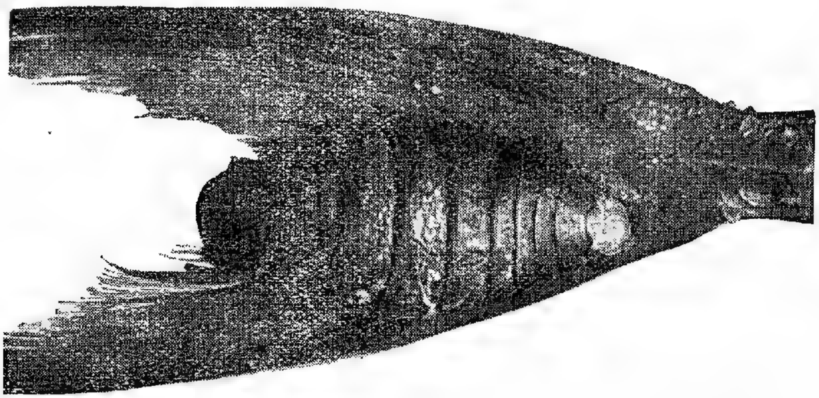

Fig. 5.
Nerocila macleayii clinging to tail of *Temnodon saltator* (2½ diam.).

Colour in alcohol: Dark olivaceous, sometimes with segments margined with paler colour, sometimes with a pale stripe on each side of mid-line of pleon; in some cases the stripes meet, thus forming a U-shaped marking on the telson.

Length, 32 mm.

Loc.—New South Wales: Port Jackson and from *Mola mola* (Austr. Mus. Coll.), Port Hacking (D. G. Stead), Shoalhaven (C. Hedley), Eden, from fin of flying gurnard (A. Cameron). Victoria: Warrnambool, from fins of *Chimaera* (J. L. Fenton). Western Australia: Nornalup Inlet, on tail of *Temnodon saltator;* Fremantle, Bunbury, and Albany (W. Austr. Mus. Coll.). No definite loc., from *Sardinia neopilchardus* (J. D. Ogilby).

Hab.—Australia and New Zealand.

According to the series before me there is not such variation in the fully developed female of this species as in *N. laticauda*. Two ovigerous females, however, taken from a pilchard, are but 21 mm. in length, are narrow in form, and have the postero-lateral angles of the sixth and seventh peraeon segments scarcely at all produced backwards (so that the last coxal plates attain the level of the posterior angles of their segment), and the pleural processes of the first

and second pleon segments are little developed; these two specimens resemble very closely an immature example figured by Chilton.[5] Other large examples, which are still in the male phase, have the posterior peraeon and anterior pleon segments produced as in the large ovigerous females. Some of the last-named are a little wider in form than the example shown in fig. 4, and others have the postero-lateral angles of the fifth peraeon segment a little backwardly produced, so that the coxal plates of this segment also do not reach to the level of the posterior angles. As in *N. laticauda*, the relative lengths of the branches of the uropods are somewhat variable.

The salient features of the adults of the species are as follows:—The postero-lateral angles of the second and third peraeon segments are never backwardly produced. The coxal plates of the seventh segment do not extend to the level of the posterior angles of that segment, except in small specimens in which the posterior angles of the segments are scarcely at all produced. The uropoda reach beyond the apex of the telson; the endopod is very obliquely truncate, with the apex acute, while the exopod is narrower and usually much longer than the endopod. The pleural processes of the first and second pleon segments reach to at least the level of the hinder margin of the fifth pleon segment in large examples; sometimes they are even longer.

N. californica, Schioedte and Meinert, appears to be closely related to *N. macleayii*.

The immature example figured by Chilton *(ut supra)* is approximately 20 mm. in length; a slightly younger form, 17 mm. in length, is here shown in fig. 4, *m*. In this specimen the antennae reach back to the posterior margin of the first peraeon segment, the uropods are much as in the "virgo" figured by Schioedte and Meinert, and the eyes are still large and prominent; in examples 20 mm. or more in length the eyes are much smaller and contain fewer facets. As previously noted, the eyes have degenerated in specimens of *N. laticauda* only 10 mm. in length. A young example of *N. macleayii*, 3·45 mm. in length, taken from the marsupium of the mother, is illustrated at *k*, fig. 4; the endopod of the uropods is wider and shorter than the exopod, and is somewhat roundly sub-truncate posteriorly.

Nerocila australasiae, Schioedte and Meinert.

Nerocila australasiae, Sch. and Mein., Naturh. Tidsskr., (3) xiii., 1881, p. 35, pl. vi., figs. 7, 8.

I have seen no specimens agreeing with the description of this species, which is evidently very closely allied to *N. macleayii*. According to the authors' figures of their single specimen, the posterior angles of all the peraeon segments are more or less produced backwards (although the angles of the second segment are apparently not at all prominent) and the endopod of the uropods is of different shape.

Length, 29 mm.

Hab.—Tasmania: "Hobarttown."

Nerocila serra, Schioedte and Meinert.

Nerocila serra, Sch. and Mein., Naturh. Tidsskr., (3) xiii., 1881, p. 17, pl. i., figs. 12-14; Nierstrasz, Zool. Medel, i., 1915, p. 74; Barnard, Ann. S. Afr. Mus., xx., 1925, p. 392.

♀. Ovigerous. About twice as long as wide. Surface glabrous, with tiny and rather sparse punctures. Cephalon wider than medianly long, with anterior margin rounded and somewhat angular in the middle; posterior margin very distinctly trilobate; eyes small but distinct. First antennae a little shorter and stouter than second, composed of eight articles; second antennae not reaching to middle of length of first peraeon segment, composed of nine articles. First

(5) Chilton, Trans. N. Z'd. Inst., xxiii., 1891, pl. xi., fig. 2.

article of palp of mandibles stouter and a little longer than second, which is distinctly longer than third. Peraeon widest at fifth segment; medial length of first segment a little greater than that of second to fourth segments, and subequal in length to fifth to seventh segments. Postero-lateral portions of all segments produced backwards and a little outwards, with the posterior angles acute; posterior angles of seventh segment reaching back almost to level of posterior angles of third pleon segment. Coxal plates well developed, falcate, all visible in dorsal view, the hinder pairs prominent; plates of second to fifth segments not or scarcely reaching beyond the posterior angles of their segments; those of sixth and seventh segments distinctly longer than their segments, the acute apices of the seventh plates reaching almost to level of posterior angles of fifth pleon segment. First five pleon segments subequal in length; pleural parts of first and

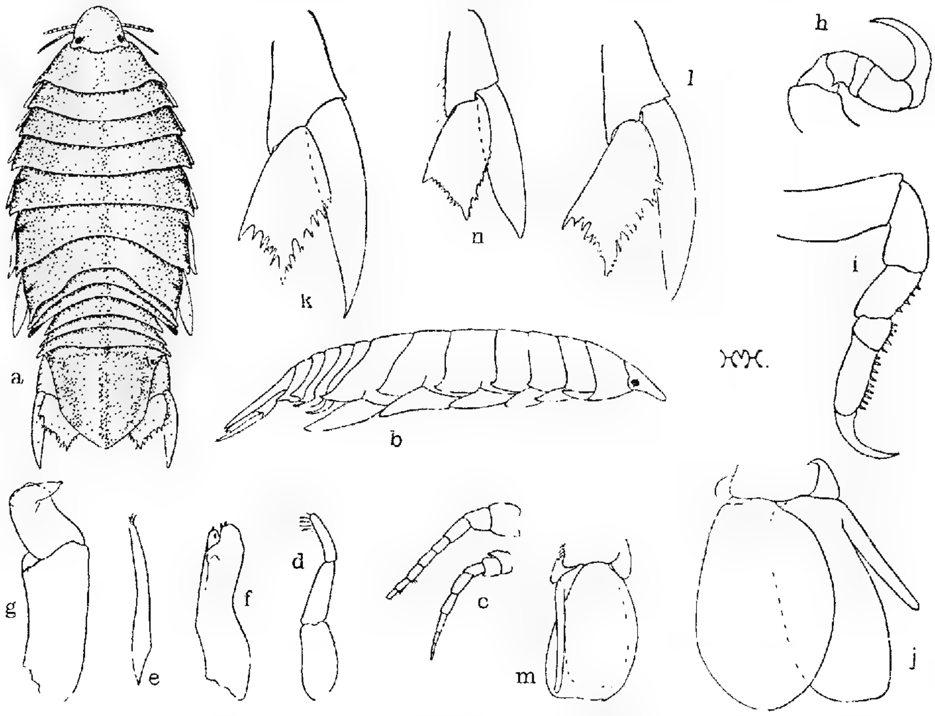

Fig. 6.

Nerocila serra. Adult male phase: *a* and *b*, dorsal and lateral views (2½ diam.); *c*, antennae (6 diam.); *d*, palp of mandible (19 diam.); *e* and *f*, first and second maxillae 19 diam.); *g*, maxilliped (19 diam.); *h* and *i*, first and seventh peraeopods (6 diam.); *j*, second pleopod (6 diam.); *k*, uropod (6 diam.). *l*, Uropod of ovigerous female (6 diam.). *m* and *n*, Second pleopod and uropod of immature example (6 diam.).

second segments produced, narrow and apically acute, those of the second segment reaching back to posterior angles of fifth segment; telsonic segment subcordate, with an obsolete median carina; basal width equal to medial length; postero-lateral margins very finely serrate. Endopod of uropods reaching beyond apex of telson, shorter and wider than exopod, with inner margin, and proximal part of outer margin, slightly convex, and with inner and outer posterior margins coarsely and conspicuously serrate; exopod falcate. Peraeopods moderately stout, successively increasing in length; seventh pair with five stout spines (two of which are shorter than the others) on inner margin of merus, five spines on inner margin of carpus, and eight or nine on inner margin of propodus.

Colour in alcohol: Dorsum yellowish with a blackish median stripe for whole length of animal, and with a blackish stripe on each side of peraeon and first five segments of pleon. Underside and peraeopods pale.

Length, 20 mm.

Loc.—Queensland: Great Palm Island, from *Lutianus* sp. (Dr. W. E. J. Paradice), Brisbane (J. D. Ogilby), Cairns (A. M. Lea).

Hab.—Malay Archipelago, South Africa (Barnard), and Queensland.

The marsupium of the female described above is filled with ova. As the ovigerous female is illustrated by Schioedte and Meinert, I have here figured an example, 22 mm. in length, in the adult male phase. This specimen differs from the ovigerous female in being of narrower form, in not having the posterior angles of the peraeon segments so much backwardly produced, and in having the last pair of coxal plates shorter, but nevertheless reaching beyond the posterior angles of the seventh peraeon segment. The pleural portions of the first and second pleon segments are not so greatly produced and the general colouration of the dorsum is darker, so that the median and lateral stripes are not prominent.

An immature specimen 16·5 mm. in length is still more slender in form, the eyes are degenerate (but are larger than in adult examples), the antennae reach back almost to the hinder margin of the first peraeon segment, and the posterior angles of only the first, sixth, and seventh peraeon segments are backwardly produced, and these but slightly; the coxal plates are less developed, but the last pair reach beyond the posterior angles of their segment. The right uropod is abnormal, but the left is much as in the adult, excepting that the serrations, while distinct, are not nearly as conspicuous (fig. 6, *n*). As in *N. laticauda* and *N. macleayii*, the male appendage of the second pleopods is relatively longer in the young than in large specimens (fig. 6, *j* and *m*). The postero-lateral borders of the telson are minutely serrate in all examples examined.

The type female figured by Schioedte and Meinert (22 mm. in length) apparently has the endopod of the uropods relatively narrower than in the Queensland specimens.

Anilocra, Leach.

Anilocra, Leach, Dict. Sci. Nat., xii., 1818, pp. 348, 350; Sch. and Mein., Naturh. Tidsskr., (3) xiii., 1881, p. 100; Stebb., Herdman's Pearl Fish., Ceylon, Suppl. Rep., xxiii., 1905, p. 25 (syn.); Rich., Bull. U.S. Nat. Mus., liv., 1905, p. 226.

The posterior margin of the cephalon is trilobate, but not prominently so. The posterior angles of the second to sixth peraeon segments are never produced (but are often produced in the preceding genus). The peraeon is rather thick and compact, the coxal plates of the fourth to seventh segments are somewhat small and do not nearly reach to the posterior angles of their segments.

Anilocra cavicauda, Richardson.

Anilocra cavicauda, Rich., Wash. Bur. Fish., Doc. 735, 1910, p. 18, fig. 17.

♀. Ovigerous. Surface smooth, with a few scattered punctures. Cephalon much wider than medianly long, narrowed in front of eyes and with anterior margin roundly subtruncate and downbent. Eyes rather large, oval, composite; widely separated and situate at postero-lateral portions of cephalon. First antennae stouter than, and about two-thirds as long as, second antennae; composed of eight articles and slightly geniculate at articulation of third and fourth articles. Second antennae reaching back to hinder margin of first peraeon segment and composed of ten articles. Peraeon widest at fifth segment; first segment longer than second or third, but shorter than any of the other segments; second to fifth segments successively increasing in length, the sixth being more than three times as long as the second segment; seventh segment subequal in length to fourth. None of coxal plates carinate; those of second and third seg-

ments subquadrate in shape, reaching to level of posterior angles of their segments; those of fourth to seventh segments curved, narrower than first two pairs and with their posterior apices far removed from the hinder angles of their respective segments. Sides of pleon converging from first to fifth segments, which are subequal in length; fifth segment scarcely more than two-thirds as wide as first segment; surface of sides of third to fifth segments concave; postero-lateral margins of fifth segment concavely incised; telsonic segment not much longer than wide, with an obsolete, longitudinal, median carina; lateral margins rounded and postero-lateral margins almost straight, abruptly converging to the narrowly subtruncate apex; basal portion tumid and sides upturned, so that the dorsum of the telson is scoop-shaped. Uropods reaching to level of apex of telson; endopod suboval, subequal in length to, but wider than, exopod, which has the inner margin almost straight and the outer margin curved. Peraeopods successively increasing in length, with dactyli of first four pairs slightly swollen in the middle of their length; seventh pair with minute spinules on inner margin of some of the joints.

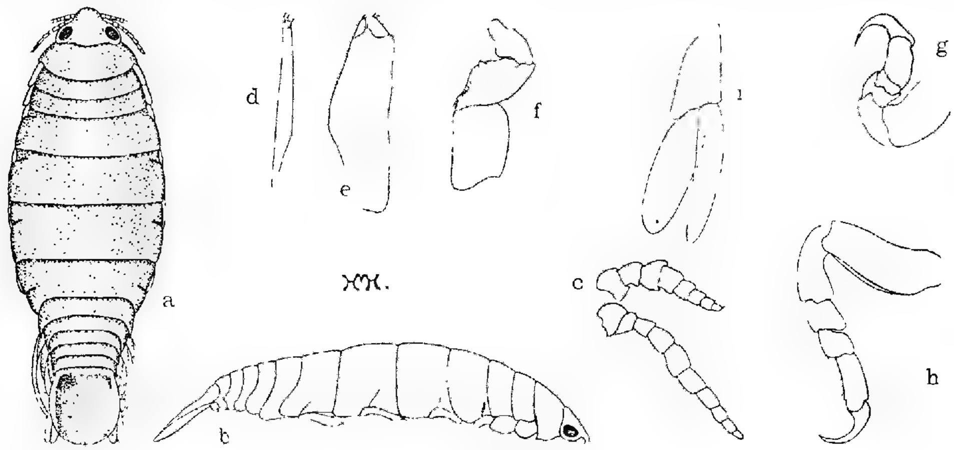

Fig. 7.

Anilocra cavicauda. Ovigerous female: *a* and *b*, dorsal and lateral views (2⅓ diam.); *c*, antennae (6 diam.); *d* and *e*, first and second maxillae (19 diam.); *f*, maxilliped (19 diam.); *g* and *h*, first and seventh peraeopods (6 diam.); *i*, uropod (6 diam.).

Colour in alcohol: Dorsum yellow, thickly dotted with brown chromatophores, so that the animal appears of an olivaceous colour.

Length, 26 mm.

Loc.—Queensland: Port Denison (E. H. Rainford).

Hab.—Philippine Islands and Queensland.

Two ovigerous females were collected by Mr. Rainford, who is responsible for the following interesting observation concerning the habit of this species:—"Found attacking side of occiput of rainbow fish *(Pentapus setosus)*. Attached by the mouth, the parasites infest about 75 per cent. of this species of fish, always in the same position." As *A. cavicauda* was previously known from a single female, it is unfortunate that a larger series of specimens was not taken.

The second female before me is 21·5 mm. in length; in this the telson is more elongate than in the example described above, and has the postero-lateral margins slightly sinuate. In both specimens the lateral parts of the rami of the first three pairs of pleopods project beyond the sides of the rather narrow pleon; chromatophores are present on the edges of the projecting portions of the pleopods.

Richardson's type is of larger size and narrower form (36 mm. in length and 10 mm. in width), and has the telsonic segment much more elongate (9 mm. in length and 5 mm. in width) than in the Australian specimens. In these last the exopod of the uropods is very slightly longer than the endopod (a reverse condition to that obtaining in the type) and the antennae are, apparently, less markedly geniculate. Richardson says that the dactyli of the first four pairs of peraeopods are "inflated in the centre," but in the specimens now described this inflation is very slight. The salient feature of *A. cavicauda* is the concave dorsum of the telson.

A. cavicauda is widely separated from the New Caledonian species, *A. australis*, Schioedte and Meinert.(6) In the last-named the exopod of the uropods is much longer than the endopod, while the Danish authors place it in a section of their key including forms which have the antennae straight and the coxal plates of the fourth to seventh segments carinate.

CYMOTHOA, Fabricius.

Cymothoa, Fabr., Entomol. Syst., ii., 1793, p. 503; Sch. and Mein., Naturh. Tidsskr., (3) xiv., 1884, p. 223; Rich., Bull. U.S. Nat. Mus., liv., 1905, p. 247.

The cephalon is more or less immersed, but the hinder margin is not trilobate; the first pair of antennae are widely separated basally, and are not expanded. The first peraeon segment has the anterior margin slightly concave or sinuate and the antero-lateral angles more or less prominently forwardly produced. The coxal plates are rather thick and prominent. The pleon is abruptly narrower than the peraeon and is deeply immersed. The basos of the posterior peraeopods is expanded.

KEY TO AUSTRALIAN SPECIES.

a. Antero-lateral angles of first peraeon segment not reaching to, or scarcely passing, level of middle of cephalon.
  b. Anterior margin of cephalon rounded .. .. *indica*
  bb. Anterior margin of cephalon widely truncate .. .. .. *limbata*
aa. Antero-lateral angles of first peraeon segment reaching to level of four-fifths of length of cephalon .. .. *vicina*

CYMOTHOA INDICA, Schioedte and Meinert.

Cymothoa indica, Sch. and Mein., Naturh. Tiddskr., (3) xiv., 1884, p. 250, pl. viii., figs. 1-4.

♀. Ovigerous. Form subovate, a little more than twice as long as greatest width. Cephalon subtriangular, about one-third wider than medianly long, with apex very narrowly subtruncate. Eyes obscure. First pair of antennae stouter than and subequal in length to second; composed of eight articles; second antennae reaching to hinder angles of cephalon, composed of nine articles. Second article of palp of mandibles a little more than twice as long as third. Peraeon widest at fourth and fifth segments, first segment much longer than any of the others, its medial length nearly equal to that of the last three segments together; antero-lateral angles not reaching forward to middle of length of cephalon; anterior margin concave, towards the sides a little sinuate, and posterior margin widely sinuate; second, third, and fourth segments subequal in length; fifth shorter than fourth and longer than sixth or seventh segment; posterior angles of all segments rounded and slightly produced outwards and downwards. Coxal plates with posterior margins nearly straight or slightly incised, not reaching quite to the posterior angles of their respective segments. First three segments of pleon subequal in length and width; fourth segment a little wider but no longer than third, and fifth wider, and longer than fourth; telsonic segment twice as wide as long, wider than fifth pleon segment; postero-lateral angles rounded and posterior margin sinuate; disc with a

(6) Sch. and Mein., Naturh. Tidsskr., (3) xiii., 1881, p. 120, pl. viii., fig. 11.

median longitudinal sulcus. Uropods reaching almost to level of hinder margin of telson; rami subequal in length, narrow, curved, and apically rounded. Peraeopods strong, successively increasing in length; carina of last four pairs pronounced, the basos of the seventh peraeopods being only about one-third longer than wide.

Colour in alcohol: Brown, becoming paler posteriorly.

Length, 29 mm.

Loc.—Western Australia: Bernier Island (W. Austr. Mus. Coll.). North-western Australia (Capt. Walcott). Queensland: N.W. Islet, Capricorn Group, "from pectoral fin of *Mugil*" (G. P. Whitley); Port Denison, Bowen, "from mouth of whiting" (E. H. Rainford).

Hab.—India, North-western and North-eastern Australia.

I am greatly indebted to Mr. E. H. Rainford for a fine series of specimens from Queensland.

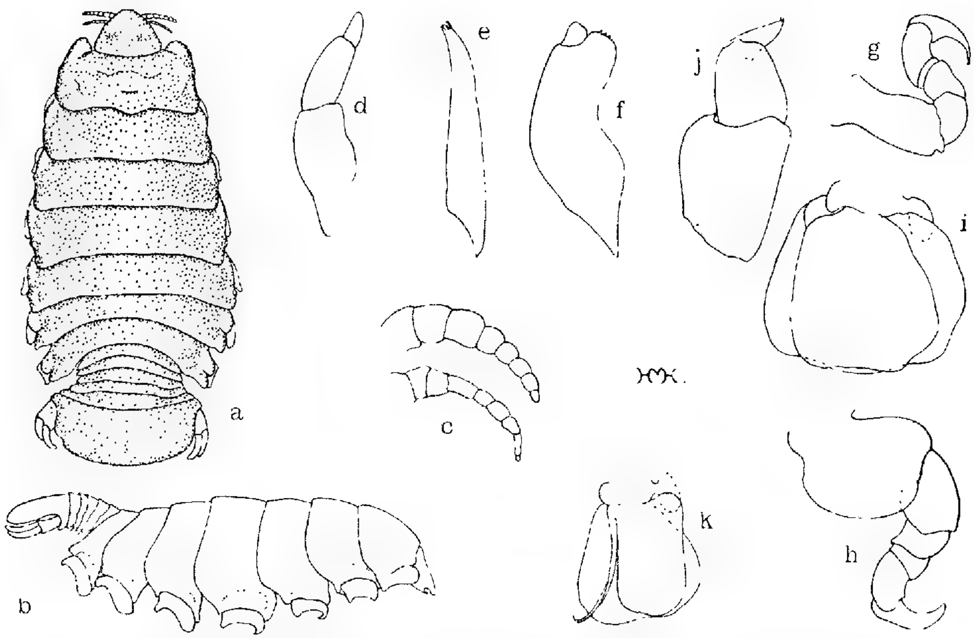

Fig. 8.

Cymothoa indica. Ovigerous female: *a* and *b*, dorsal and lateral views (1¾ diam.); *c*, antennae (9 diam.); *d*, palp of mandible (29 diam.); *e* and *f*, first and second maxillae (20 diam.); *g* and *h*, first and seventh peraeopods (4 diam.); *i*, first pleopod (4 diam.). Adult male phase: *j*, maxilliped (29 diam.); *k*, second pleopod (4 diam.).

An example 20 mm. in length, in the adult male phase, has the cephalon almost as long as its basal width, the greater part of the first pleon segment hidden beneath the last peraeon segment, and the telsonic segment relatively longer than in the ovigerous female; also the coxal plates are a little longer, those of the second, third, and fourth peraeon segments reaching quite to the posterior angles of these segments. The male appendage is long and tapering, and exceeds the rami of the second pleopods in length. Schioedte and Meinert examined two specimens, an ovigerous female 20 mm. in length and one "mas adultus" only 9 mm. in length. A small male (10 mm. in length) from Queensland is very like the last-named example.

Cymothoa limbata, Schioedte and Meinert.

Cymothoa limbata, Sch. and Mein., Naturh. Tidsskr., (3) xiv., 1884, p. 250, pl. vii., figs. 1, 2.

C. limbata and *C. indica* are both included by the Danish authors in Section ii. of their "Conspectus systematicus specierum";[7] this section contains forms which have the antero-lateral angles of the first peraeon segment nearly reaching or slightly passing the level of the middle of the length of the cephalon. *C. limbata* differs from *C. indica* in that the anterior margin of the cephalon is truncate. The telsonic segment is distinctly longer than the remaining segments of the pleon together. I have not seen this species, which is described from a single "virgo."

Length, 17 mm.

Hab.—Queensland: Cape York.

Cymothoa vicina, n. sp.

♀. Ovigerous. Form suboval, a little more than twice as long as greatest width. Cephalon subtriangular, nearly half as wide again as medially long; anteriorly with a short, longitudinal, median sulcus; with lateral margins slightly sinuate and anterior margin very narrowly subtruncate. Eyes distinct, rather

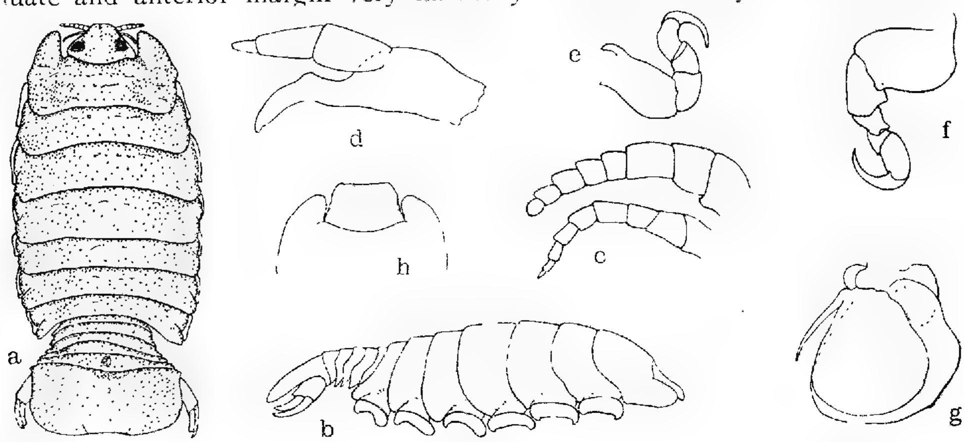

Fig. 9.

Cymothoa vicina, type ovigerous female: *a* and *b*, dorsal and lateral views (2¼ diam.); *c*, antennae (9 diam.); *d*, mandible (20 diam.); *e* and *f*, first and seventh peraeopods (5 diam.); *g*, second pleopod (5 diam.). *h*, Cephalon and first peraeon segment of ovigerous female of *C. stromatei* (2 diam.).

small. First pair of antennae stouter than and subequal in length to second pair; composed of eight articles; second antennae reaching to hinder angles of cephalon, composed of nine articles. Second article of palp of mandibles scarcely more than twice as long as the third. Peraeon widest at third and fourth segments; first segment longer than any of the others, its medial length equal to that of the fifth and sixth segments together; antero-lateral angles reaching to level of four-fifths of length of cephalon; anterior margin sinuate and posterior margin very slightly sinuate; second, third, and fourth segments successively increasing slightly in length; fifth abruptly shorter, equal in length to sixth; seventh segment shortest; posterior angles of all segments obtusely rounded, scarcely at all produced. Coxal plates with posterior margins rounded, not reaching to level of hinder angles of their respective segments. First four segments of pleon subequal in length and width; fifth longer and wider; telsonic segment twice as wide as long, a little wider than fifth segment, with postero-lateral and hinder margins

(7) Sch. and Mein., Naturh. Tidsskr., (3) xiv., 1884, pp. 225, 226.

rounded. Uropods reaching to level of apex of telson, with both branches curved and narrowly rounded apically; exopod longer and a little wider than endopod. Peraeopods strong, successively increasing in length backwards; carina of last four pairs moderately produced, the basos of the seventh peraeopods being half as long again as wide.

Colour in alcohol: Dark yellow.

Length, 19 mm.

Loc.—New South Wales: Tweed River, from a mullet (Franks). Type in Australian Museum, Reg. No. P8590.

The male appendage of the second pleopods is retained in the single ovigerous female before me (fig. 9, *g*). This species belongs to Section iii. of the key given by Schioedte and Meinert *(C. stromatei, C. oestrum,* etc.), but differs from the species placed there by these authors in not having the anterior margin of the cephalon broadly truncate or concave. In the accompanying figure the cephalon of a specimen of *C. stromatei* from New Guinea is shown for comparison.

LIVONECA, Leach.

Livoneca, Leach, Dict. Sci. Nat., xii., 1818, p. 551; Sch. and Mein., Naturh. Tidsskr., (3) xiv., 1884, p. 340; Barn., Ann. S. Afr. Mus., xvii., 1920, p. 357 (syn.).

Cephalon more or less immersed. First pair of antennae not expanded but rather compressed; widely separated at the base. First peraeon segment abruptly longer than second (in which case the seventh segment is abruptly shorter than sixth) or subequal in length to other segments. Coxal plates rarely wide. Peraeopods subequal in length or successively increasing slightly in length backwards; carina of basos of last four pairs more or less prominent. Pleon rarely strongly immersed in peraeon.

KEY TO AUSTRALIAN SPECIES.

a. Front of cephalon not widely subtruncate; second antennae much longer than first .. .. *raynaudii*

aa. Front of cephalon widely subtruncate; second antennae not longer than first .. .. *turgidula*

LIVONECA RAYNAUDII, Milne Edwards.

Livoneca raynaudii, M. Edw., Hist. Nat. Crust., iii., 1840, p. 262; Sch. and Mein., Naturh. Tidsskr., (3) xiv., 1884, p. 367, pl. xv., figs. 9-13; Whitelegge, Mem. Austr. Mus., iv., 1901, p. 236; Stebb., Ann. S. Afr. Mus., vi., 1910, p. 425; Thielemann, München Abh. Akad. Wiss., ii., Suppl. 3, 1911, p. 42; Barn., Ann. S. Afr. Mus., xvii., 1920, p. 358; Chilton, Rec. Cant. Mus., i., 1911, p. 309, and Trans. N. Z'd. Inst., xliv., 1912, p. 135.

Livoneca novae zealandiae, Miers, Ann. Mag. Nat. Hist., (4) xvii., 1876, p. 228, and Cat. Crust. N. Z'd., 1876, p. 106, pl. iii., fig. 2.

Livoneca stewarti, Filhol., Mission d'Ile Campbell, iii., 1885, p. 450, pl. lv., fig. 6.

♀. Ovigerous. Form suboval, about one and three-fourths times as long as wide. Cephalon immersed in first peraeon segment, subpentagonal in shape, slightly wider than medial length; front suddenly narrowed near apex, which is rounded; dorsum shallowly excavate. Eyes rather small, suboval. First antennae composed of eight articles; second antennae one-half as long again as first, composed of twelve articles. First article of palp of mandibles a little longer than second and third together; second much longer than third article, which bears a few setae near and at apex. Peraeon moderately convex; first segment slightly longer than the others, which are subequal in length. Coxal plates of second to fifth segments subpendulous, of sixth and seventh continued almost in same plane as their segments; plates of second and third segments almost or quite reaching to postero-lateral angles of their segments, and remaining plates not attaining hinder angles of their segments. First pleon segment partly concealed beneath last peraeon segment; second to fifth segments subequal

in width, the fifth a little longer than second to fourth, which are subequal in length; telsonic segment a little less than twice as wide as medial length, with hinder margin semicircular, and with an obsolete, median carina on basal half of dorsum. Uropods not reaching much beyond level of middle of length of telsonic segment; both branches suboval and slightly tapering, the exopod a little larger than the endopod. Peraeopods rather stout, successively increasing in length backwards; basos of first three pairs with a low carina; basos of last four pairs with a carina, which is somewhat prominently produced near the proximal end. Pleopods successively decreasing in size backwards, the outer ramus of each longer and much wider than the inner.

Colour in alcohol: Yellow.

Length, 38 mm.

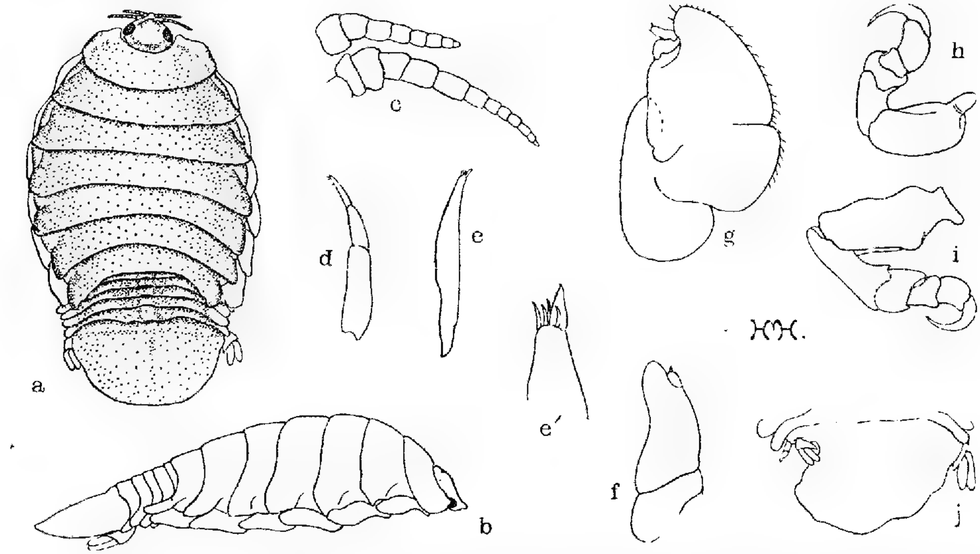

Fig. 10.

Livoneca raynaudii. Ovigerous female: *a* and *b*, dorsal and lateral views (1⅓ diam.); *c*, antennae (6½ diam.); *d*, palp of mandible (10 diam.); *e* and *f*, first and second maxillae (10 diam.); *e′* apex of first maxilla (42 diam.); *g*, maxilliped (6½ diam.); *h* and *i*, first and seventh peraeopods (3½ diam.); *j*, abnormal telsonic segment of another specimen (1¦ diam.).

♂. Differs from the ovigerous female as follows:—Antennae relatively a little longer (but composed of the same number of articles), peraeopods more slender and form narrower, about two and one-third times longer than wide. All coxal plates reaching nearly or quite to level of hinder angles of their segments. Telson a little longer in proportion to its width and more triangular in shape. Male appendage of second pleopods not much shorter than large outer ramus. Branches of uropods with a few short hairs on inner and apical margins; exopod longer than endopod, sometimes reaching to level of apex of pleon.

Length, 17·5-19 mm.

Loc.—New South Wales: Sydney (Raphael), off Cape Three Points, Jibbon, Wata Mooli, and Coogee, 32-78 faths. ("Thetis" Exped.), Terrigal (D. G. Stead), off Botany Bay, 33-56 faths. (C. W. Mulvey, F. A. McNeill, and A. Livingstone), Port Jackson, 65-75 faths., from *Zeus faber* and a Scorpaenid, and off Green Cape, 30-40 faths., from a flathead (W. Boardman and G. P. Whitley). South Australia: Port Adelaide (S. Austr. Mus. Coll.). Tasmania (A. M. Lea).

Hab.—South Africa, Japan, Australia, and New Zealand.

This species is apparently not subject to very great distortion; some specimens are quite symmetrical, others are curved slightly to the left, others to the right. The front of the cephalon may be very narrowly subtruncate, and not or scarcely constricted near the apex. All the coxal plates may extend back to the level of the postero-lateral angles of their respective segments.

The telsonic segment of an abnormal female is shown at *j*, fig. 10; the right uropod is normal, but on the left, and damaged, side two uropods (one of which is uniramous) have been developed.

As remarked by Chilton *L. epimerias,* Rich,[8] from Japan, is apparently very close to *L. raynaudii.*

Livoneca turgidula, n. sp.

♀. Form somewhat ovate, about twice as long as greatest width. Cephalon not deeply immersed in first peraeon segment, slightly bent downwards anteriorly, and a little longer than basal width; lateral margins concave and front truncate, very slightly convex; dorsum with two shallow, adjoining foveae. Eyes small, suboval, situate at postero-lateral angles of cephalon. Antennae short, composed of eight articles in both pairs; second pair more slender and a little shorter than first. First article of palp of mandibles as long as second and third together;

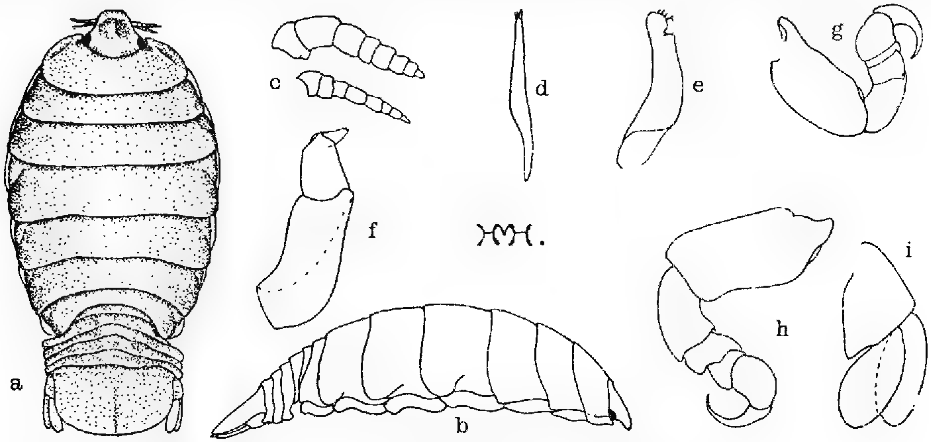

Fig. 11.

Livoneca turgidula, type, female: *a* and *b*, dorsal and lateral views (3 diam.); *c*, antennae (12 diam.); *d* and *e*, first and second maxillae (18 diam.); *f*, maxilliped (18 diam.); *g* and *h*, first and seventh peraeopods ($8\frac{1}{2}$ diam.); *i*, uropod ($8\frac{1}{2}$ diam.).

third about half as long as second, with a few short apical setae. Peraeon moderately convex, suboval in shape; antero-lateral angles of first segment acute, reaching to anterior margins of eyes, and dorsum with a deep groove on each side near lateral margins; first and fourth segments subequal in length, longer than any of the others; second and sixth subequal in length, a little longer than third and fifth segments, which are subequal in length; seventh segment abruptly shorter. Coxal plates thick, very narrow in dorsal view, rounded posteriorly, only the last pair reaching to the posterior angles of their segment. First pleon segment partly concealed beneath last peraeon segment; second to fifth segments subequal in length and width (right lateral portion of second abnormal), as wide as the seventh peraeon segment; telsonic segment nearly twice as wide as medianly long, subrectangular in shape, with postero-lateral margins and hinder margin rounded; dorsum with a low median carina, lightly excavate and shallowly pitted

(8) Rich., Proc. U.S. Nat. Mus., xxxvii., 1910, p. 88, fig. 13.

on each side of carina. Uropods reaching to level of hinder margin of telson, with branches suboval in shape and subequal in length; endopod a little wider than exopod. Peraeopods moderately stout, successively increasing in length; basos of each with a low but distinct carina. Pleopods successively decreasing in size backwards, the outer ramus much wider and longer than inner in the first two pairs, less markedly wider and longer in the three posterior pairs.

Length, 16·5 mm.

♂. Less robust than the female, about two and one-half times as long as greatest width. Male appendage of second pleopods as long as rami.

Length, 10·5 mm.

Loc.—Western Australia: Fremantle (type locality) and Cottesloe (L. Glauert). Type, female, and allotype, male, in W. Austr. Mus., Reg. Nos. 10034 and 11126.

This species resembles *L. philippinensis*, Rich.,[9] in the small size, the short antennae, and the irregular lengths of the peraeon segments. Richardson's species differs, however, in having the cephalon wider than long and rounded in front, the telson of different shape, etc.

Irona, Schioedte and Meinert.

Irona, Sch. and Mein., Naturh. Tidsskr., (3) xiv., 1884, p. 381; Stebb., Herdman's Ceylon Pearl Fish., Suppl. xxiii., 1905, p. 27; Rich., Bull. U.S. Nat. Mus., liv., 1905, p. 265.

Front of cephalon rather broadly rounded. First segment of peraeon sublunate, longer than the second. Posterior coxal plates usually wide or rather wide. Carina of basos of last four pairs of peraeopods obsolete. Pleon usually strongly immersed in the peraeon, the first segment wholly or for the greater part covered by the last peraeon segment.

Irona is close to *Livoneca*, but one or more of the above somewhat inconstant characters serve to distinguish the females of the species of the genus. No species has been previously noted from Australian coasts, but at least the two following occur:—

Key to Australian Species.

a. Coxal plates thick, comparatively narrow, convex fore and aft, and transversely. Eyes moderately large. Peraeopods stout .. .. .. *renardi*

aa. Coxal plates thin, wide, and flat. Eyes larger. Peraeopods more slender *melanosticta*

Irona renardi, Bleeker.

Livoneca renardi, Bleek., Acta. Soc. Scient. Indo-Neerland., ii., 1857, p. 28, pl. i., fig. 8.

Lironeca renardi, Miers, Ann. Mag. Nat. Hist., (5) v., 1880, p. 465.

Irona renardi, Sch. and Mein., Naturh. Tidsskr., (3) xiv., 1884, p. 383, pl. xvi., figs. 10, 11.

♀. Ovigerous. Form irregularly subovate, twice as long as greatest width. Cephalon strongly immersed in first peraeon segment, suborbiculate, about one-third wider than medial length, and with front obtuse. Eyes moderately large. Labrum about one-fourth wider than long; slightly emarginate. Antennae short, the first pair stouter than second; both composed of seven articles. Oral appendages stout. First article of palp of mandibles equal to second and third together; third article short. Basipodite of maxillipeds twice as long as greatest width. Peraeon transversely convex, widest at second and third segments; first segment sublunate, much longer than any of the others, with posterior margin sinuate towards sides; antero-lateral angles narrowly rounded and reaching almost to level of anterior margins of eyes; second segment longer than third, which is longer than the four posterior segments, which are subequal in length. Coxal plates thick, not very wide, convex transversely and fore and aft; first

[9] Rich., Bur. of Fish., Doc. No. 736, 1910, p. 24, fig. 23.

two pairs not reaching to hinder angles of their segments, and last four pairs extending to the posterior angles of their segments; plates of second to fourth segments acutely rounded posteriorly, of fifth to seventh segments obtusely rounded. Pleon deeply immersed in peraeon, which covers the first two segments (the lateral parts of which are, however, visible in lateral view); lateral margins short, almost straight or slightly incised; telsonic segment rounded, not much wider than medial length, as wide as fourth pleon segment; dorsum marked with faint pits. Uropods reaching well beyond apex of pleon; both rami long and narrow, curved or a little sinuate, the endopod shorter and narrower than the

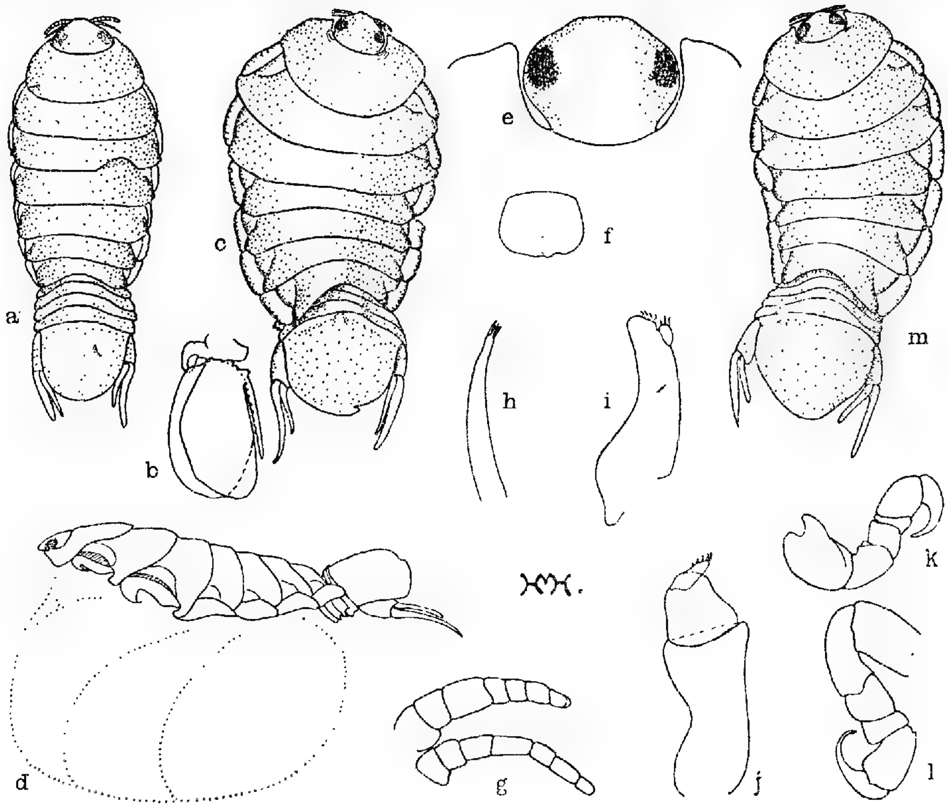

Fig. 12.

Irona renardi. Male: *a*, dorsal view (2½ diam.); *b*, second pleopod (4 diam.). Ovigerous female: *c* and *d*, dorsal and lateral views (1¾ diam.); *e*, cephalon (5⅓ diam.); *f*, labrum (10 diam.); *g*, antennae (22 diam.); *h* and *i*, first and second maxillae (14 diam.); *j*, maxilliped (11 diam.); *k* and *l*, first and seventh peraeopods (4 diam.). *m*, Dorsal view of another female (2⅙ diam.).

exopod. Peraeopods stout, successively increasing in length backwards; dactyli strong; seventh peraeopods a little longer than sixth.

Colour in alcohol: White with small chromatophores on the telson, uropods, and pleopods.

Length, 29 mm.

♂. The form is subovate and is more slender (two and one-half times longer than wide) and more symmetrical, and the cephalon is relatively larger than in the ovigerous female. First antennae composed of eight articles, the second of nine. Peraeon widest at third segment; first segment longest, with

antero-lateral angles subacute, reaching to level of middle of length of eyes. Coxal plates of second to fourth segments subtruncate posteriorly, of fifth to seventh segments obtusely rounded. All segments of pleon visible in dorsal view. Male appendage of second pleopods not nearly reaching to end of rami.

Colour: Whitish, closely dotted with small chromatophores, which are most distinct posteriorly.

Length, 19 mm.

Loc.—New South Wales: Georges River, Botany Bay (J. H. Wright), under gill-cover of *Tylosurus ferox* (D. G. Stead), Port Jackson, and Camden Haven, under gill-cover of *Tylosurus macleayana* (Austr. Mus. Coll.). Queensland: Townsville, from *Tylosurus* sp. (Dr. W. E. J. Paradice). Western Australia: Fremantle (W. Austr. Mus. Coll.).

Hab.—India, Philippine Islands and Australia (? Batavia-Bleeker).

The male and female described and illustrated above were taken together at Sans Souci, Georges River; a second ovigerous female, 24·5 mm. in length, from Queensland, is shown at *m*, fig. 12. In females which are curved to the left the pleon is tilted to the right, and on this side is more or less overlapped by the postero-lateral portion of the peraeon; a reverse condition obtains in specimens curved to the right. At least the first pleon segment is concealed beneath the peraeon in the ovigerous female; the peraeon is not consistently subovate, and in one example it is suboval.

Three males which, apparently, should be referred to this species were taken from *Tylosurus macleayana* in New South Wales. The smallest of these is 16·5 mm. in length, is three times as long as wide, and has the telson elongate, longer than wide; both branches of the uropods are ciliate, and the exopod is slightly longer and narrower than the suboval endopod. A second specimen is 17·5 mm. in length, and is little more than two and one-half times as long as wide; the telson is scarcely wider than long, and the uropods are more as in the male described in detail above, but are relatively shorter. The third example is 23 mm. in length; the male appendage of the second pleopods is much shorter than the rami.

IRONA MELANOSTICTA, Schioedte and Meinert.

Irona melanosticta, Sch. and Mein., Naturh. Tidsskr., (3) xiv., 1884, p. 388, pl. xvii., figs. 3-5; Thielemann, München Abh. Akad., Wiss., ii., Suppl. 3, 1911, p. 45, pl. ii., figs. 28, 29; Barn., Ann. S. Afr. Mus., x., 1914, p. 373.

♀. Ovigerous. Form irregularly suboval, twice as long as greatest width. Cephalon immersed in first peraeon segment, suborbiculate, wider than long, with front obtuse. Eyes large. Labrum slightly emarginate. First antennae much stouter than second, composed of eight articles; second pair composed of nine articles. Oral appendages rather slender. First and second articles of palp of mandibles subequal in length, each two and three-fourths as long as third. Basipodite of maxillipeds two and one-half times longer than greatest width. Peraeon slightly convex transversely, widest at fourth segment; first segment sublunate, as long as the third, and a little longer than second segment, with posterior margin a little sinuate towards sides; antero-lateral angles rounded, reaching to level of eyes; four posterior segments successively decreasing in length backwards. Coxal plates wide and rather thin, slightly convex fore and aft, and continued quite or nearly in the same plane as their segments; plates of second segment reaching to postero-lateral angles of their segment and remaining plates extending distinctly beyond hinder angles of their segments; first three pairs with outer margins more or less sinuate and posterior apices rounded; last three pairs with outer margins convex and apices rather narrowly rounded; plates of third and fourth segments longer than the others. Pleon immersed in peraeon, the first segment not wholly concealed; first four segments subequal in length, fifth

a little longer; lateral margin of anterior five segments rounded; posterior portion of telson membranaceous, with shallow pits, the hinder margin irregular; the greater part of the telsonic segment is more strongly chitinized than the hinder portion; this firm portion is twice as wide as medianly long, semicircular in shape

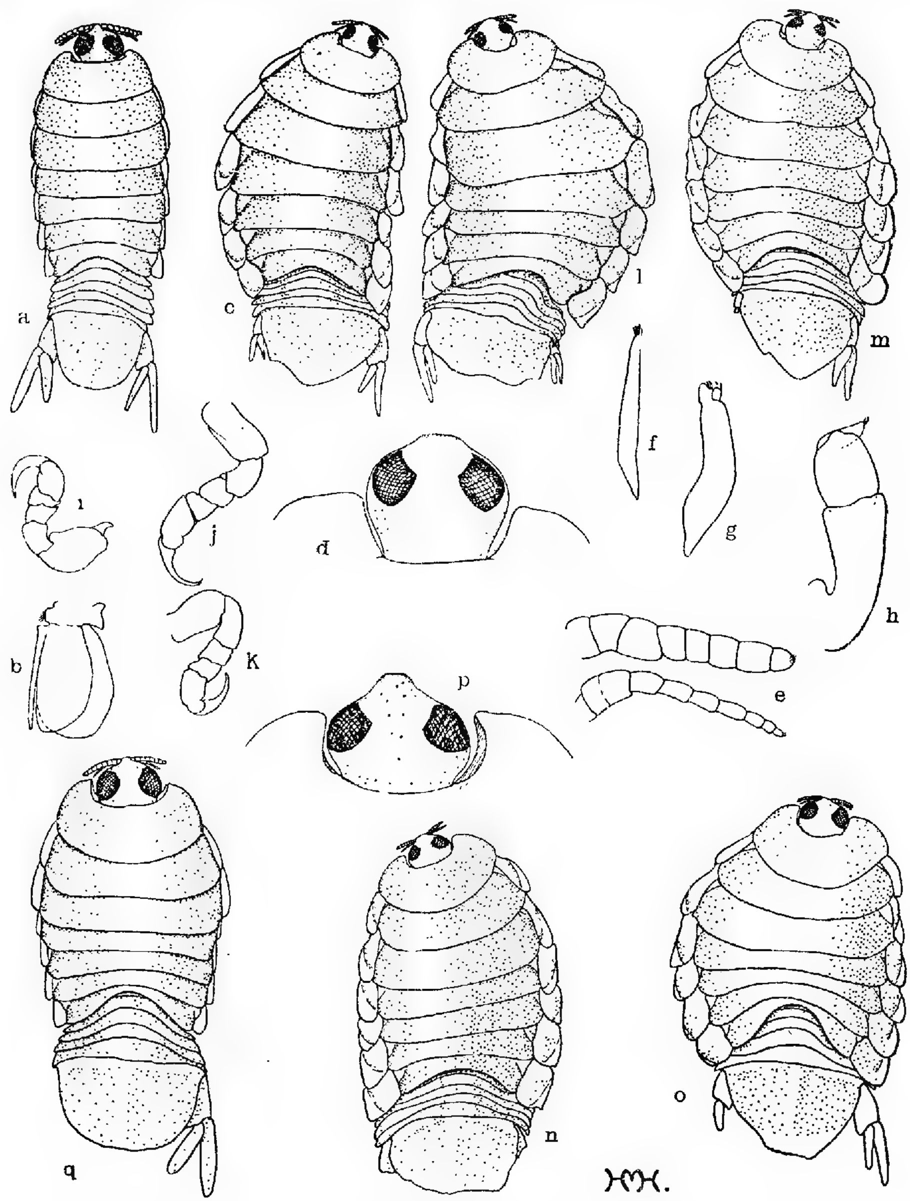

Fig. 13.
Irona melanosticta. Male: *a*, dorsal view ($3\frac{1}{2}$ diam.); *b*, second pleopod (6 diam.). Ovigerous female: *c*, dorsal view (3 diam.); *d*, cephalon ($8\frac{1}{2}$ diam.); *e*, antennae (21 diam.); *f* and *g*, first and second maxillae (21 diam.); *h*, maxilliped (21 diam.); *i*, *j*, and *k*, first, sixth, and seventh peraeopods (6 diam.). *l*, *m*, *n*, and *o*, Dorsal views of other ovigerous females (2 to $3\frac{1}{2}$ diam.). *p*, Cephalon of ovigerous female ($8\frac{1}{2}$ diam.) *q*, Dorsal view of another male ($4\frac{3}{4}$ diam.).

posteriorly, and faintly pitted. Left uropod abnormal, with rami rather short and subequal in length; right uropod reaching well beyond apex of pleon, both branches thin and narrow, the exopod very slightly sinuate and longer and slightly wider than endopod. Peraeopods moderately stout, successively increasing in length backwards to the fifth pair; seventh peraeopods not longer than sixth.

Colour in alcohol: Brownish, paler on telson.

Length, 17 mm.

♂. The form is subovate and is more slender (two and three-fourths times as long as greatest width) and more symmetrical, and the cephalon is relatively larger than in the ovigerous female. First antennae composed of eight, and second of nine articles. Peraeon widest at third segment; first segment longest, with antero-lateral angles rounded and not very produced. Coxal plates of second and third segments obtuse posteriorly, larger than the remaining pairs, which are narrowly rounded posteriorly; telsonic segment a little wider than medial length, posterior margin rounded and dorsum shallowly pitted and with a low median carina. Male appendage of second pleopods reaching to level of apex of inner ramus. Both rami of uropods reaching well beyond apex of pleon, the exopod longer and wider than the endopod.

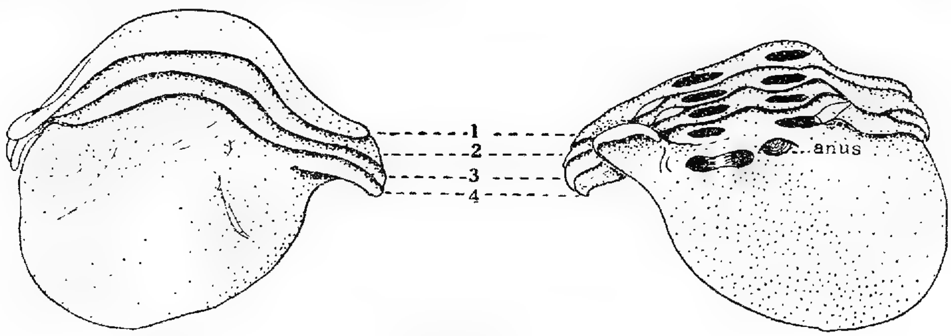

Fig. 14.

Irona melanosticta. Dorsal and ventral views of abnormal pleon of ovigerous female; pleopods removed (5 diam.).

Colour: Brownish, paler on telson.

Length, 14 mm.

Loc.—South Australia: Port Victor (Bradley), Gulf St. Vincent, and Port Adelaide (S. Austr. Mus. Coll.).

Hab.—Japan, Sandwich Islands, Australia, and South Africa.

The coxal plates of the ovigerous female of this species are very different from those of *I. renardi.* Eighteen specimens, all taken from beneath the gill-covers of garfish *(Hyporhamphus intermedius)*, are before me; the largest female is 25 mm. in length. The "long toms" *(Tylosurus,* from which some specimens of the preceding species were taken) do not occur in South Australia, but Thielemann notes that *I. melanosticta* is found on "*Belone* sp." in Japan, and Barnard records it from "*Tylosurus choram*" in South Africa.

The cephalon is somewhat variable in shape and may be apically obtuse or (rarely) somewhat triangular, with the antero-lateral margins sinuate (fig. 13, *p*). The form may be relatively much wider than in the examples described above owing to greater distortion or "telescoping" of the segments of the peraeon, as in the male shown at *q*, and in the ovigerous females at *l*, *m*, and *o*. The coxal plates are variable in size and shape, but are always thin and nearly flat; more or less of the postero-lateral part of each is softer and somewhat thicker than the rest.

but in dried examples this fleshy portion shrinks and becomes thin and membranaceous. In some specimens the pleon is far more deeply immersed in the peraeon than in others (cf. females *n* and *o*). The hinder margin of the membranaceous posterior part of the telson of the ovigerous female is almost always irregular, but the more strongly chitinized, semicircular basal part is consistently about twice as wide as long, as in the example figured by Schioedte and Meinert. In this sex the uropods are commonly abnormal on one side or the other (sometimes on both sides), but the uropods of the male, and normal uropods of the female, are as described by Barnard.

One much distorted ovigerous female presents an abnormality of some interest. This example is curved to the left, and the pleon (fig. 14) consists of only four separate segments, the fourth and fifth being fused with the telsonic segment, so that the last two pairs of pleopods are attached to the underside of the enlarged "telson." The first three segments are twisted but distinct, and the fourth is represented by a short lateral piece on the right side. The lateral portions of the anterior margin of the telsonic segment are decurved. Uropods are wholly absent.

Codonophilus, Haswell.

Codonophilus, Hasw., Proc. Linn. Soc. N.S. Wales, v., 1881, p. 471, and Cat. Austr. Crust., 1882, p. 283.

Ceratothoa, Sch. and Mein., Naturh. Tidsskr., (3) xiii., 1883, p. 322 (*nec* Dana, 1853).

Meinertia, Stebb., Hist. of Crust., 1893, p. 354, and Mar. Invest. S. Afr., i., 1900, p. 57, and Ann. S. Afr. Mus., vi., 1910, p. 424.

The cephalon is more or less immersed, but its hinder margin is not trilobate. The first pair of antennae are expanded and are basally contiguous. The first peraeon segment has the anterior margin almost straight, or more or less strongly bisinuate, and the antero-lateral angles forwardly produced. The coxal plates are thick and prominent. The pleon is immersed in the peraeon. The first three pairs of peraeopods are shorter than the others; the basos of the posterior peraeopods is expanded.

As before, the generic diagnosis applies to the mature adults. As noted below Haswell's *Codonophilus* was founded upon an immature specimen of Fabricius' *Cymothoa imbricata*. Unfortunately, Haswell's genus antedates *Meinertia* of Stebbing, so that the species referred to the last-named genus must now be transferred to *Codonophilus*.

Codonophilus imbricatus, Fabricius.

Oniscus imbricatus, Fabr., Mantissa Insect., i., 1787, p. 241.

Cymothoa imbricata, Fabr., Entom. Syst., ii., 1793, p. 503, and Suppl., 1798, p. 304.

Cymothoa banksii, Leach, Dict. Sci. Nat., xii., 1818, p. 353; M. Edw., Hist. Nat. Crust., iii., 1840, p. 273; Krauss, Die Südafrikanischen Crust., 1843, p. 66; Heller, Reise der Novara Crust., 1868, p. 148.

Cymothoa trigonocephala, Leach, *loc. cit.*, p. 353; M. Edw., Ann. Sci. Nat., (2) iii., 1835, pl. xiv., figs. 1, 2, and Règne Animal (1839 ?), pl. lxv., fig. 2, and Hist. Nat. Crust., iii., 1840, p. 272.

Ceratothoa trigonocephala, Heller, *loc. cit.*, p. 148; Thomson, Trans. N. Z'd. Inst., xi., 1879, p. 233; Miers, Ann. Mag. Nat. Hist., (5) v, 1880, p. 463; Hasw., Cat. Austr. Crust., 1882, p. 282; Sch. and Mein., Naturh. Tidsskr., (3) xiii., 1883, p. 358, pl. xvi., figs. 1-7.

Ceratothoa banksii, Miers, Cat. Crust. N. Z'd., 1876, p. 105; Sch. and Mein., *loc. cit.*, p. 340, pl. xiv., figs. 6-21; Hansen, Cirolanidae, 1890, p. 68, pl. x., fig. 4.

Codonophilus argus, Hasw., Proc. Linn. Soc. N.S. Wales, v., 1881, p. 471, pl. xvi., figs. 1, 1*c*, and 1*g*, and Cat. Austr. Crust., 1882, p. 283.

Ceratothoa imbricata, Miers, Zool. "Alert," 1884, p. 300.

Meinertia imbricata, Stebb., Hist. of Crust., 1893, p. 354, and Mar. Invest. S. Afr., i., 1900, p. 58, and Ann. S. Afr. Mus., vi., 1910, p. 424; Chilton, Trans. N. Z'd. Inst., xliii., 1911, p. 567.

Meinertia trigonocephala, Thielemann, München Abh. Akad. Wiss., ii., Suppl. 3, 1911, p. 35, pl. i., figs. 8, 9.

The following variation is evident in ovigerous females:—Cephalon subtriangular, longer than wide, sometimes three-fourths as long again as basal width; apex obtuse or subacute, the front occasionally considerably narrowed; lateral margins rounded and scarcely sinuate, or emarginate. Eyes usually distinct, rhomboidal or suboval, usually with inner margins almost straight. Normally, the first antennae are composed of seven articles and the second of nine. Produced antero-lateral parts of first peraeon segment wide and apically rounded, or tapering and apically acute; anterior margin of first segment nearly straight (slightly concave or convex) or more or less bisinuate (occasionally conspicuously so). Fifth segment of pleon with hinder margin more or less distinctly trisinuate; telsonic segment about twice as wide as medial length, rarely perfectly symmetrical, with hinder margin rounded. Normally the rami of the uropods are narrow, falcate, and subequal in length (fig. 15, *i*).

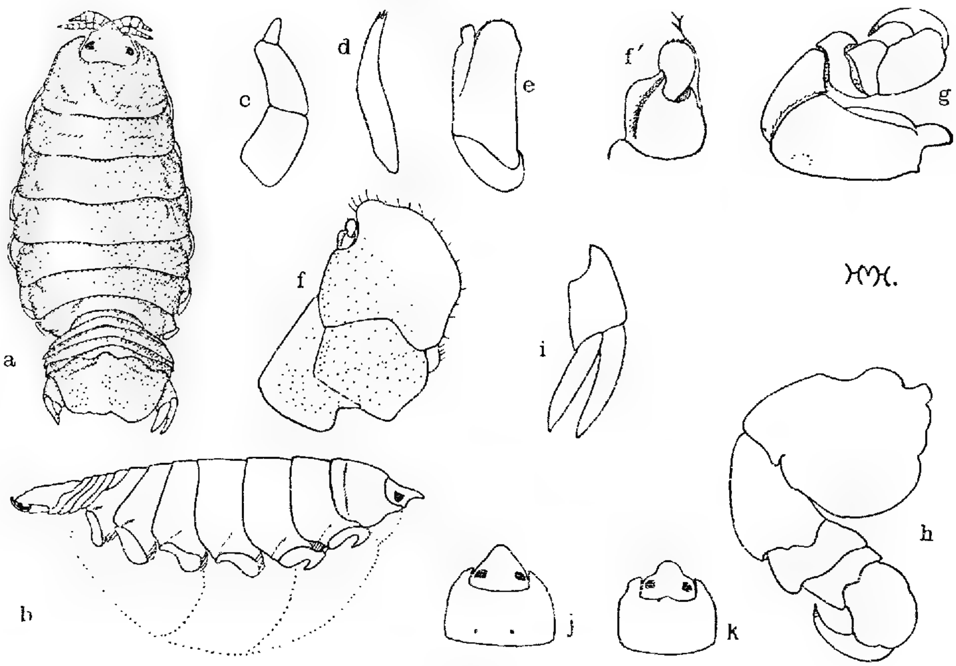

Fig. 15.

Codonophilus imbricatus. Ovigerous female: *a* and *b*, dorsal and lateral views (1¼ diam.); *c*, palp of mandible (8 diam.); *d* and *e*, first and second maxillae (8 diam.); *f*, maxilliped (6 diam.); *f′*, palp of maxilliped (19 diam.); *g* and *h*, first and seventh peraeopods (4 diam.). *i*, Uropod of a smaller female (8 diam.). *j* and *k*, Cephalon and first peraeon segment of two other examples (1½ diam.).

The smallest of the ovigerous females before me is 16·5 mm. in length, the largest 49 mm.; Stebbing states that the female attains a length of 57 mm. The ova of one of the small examples are, approximately, 2 mm. in diameter; those of a very large female are slightly larger.

An ovigerous female 44 mm. in length is illustrated in fig. 15, *a* to *h*; the cephalon and first peraeon segment of two smaller specimens, taken from the tongue of a mullet, are shown at *j* and *k*.

The species has been recorded from the Indian Ocean, Java, New Zealand, Australia, and South Africa. It is moderately common in Australian waters, and there is before me a series of more than one hundred adult specimens from various

localities off the eastern, southern, and western coasts. In the majority of cases the host is not noted, but some labels show that the parasite occurs in the mouth or under the gill-cover of the yellow-tail *(Trachurus declivis)*, schnapper *(Pagrosomus auratus)*, red gurnard *(Chelidonichthys kumu)*, blackfish *(Girella tricuspidata)*, trevally *(Caranx georgianus)*, and mullet *(Mugil)*.

Miers *(ut supra*, 1884) compared Fabricius' type of *Cymothoa imbricata* with the type examples of *C. trigonocephala*, Leach, and states that it is probable that the last-named species is synonymous with the first; he adds that he keeps them provisionally distinct because in the type of *C. trigonocephala* "the head is narrower, more distinctly triangulate, with straight sides, and the anterior thoracic segment proportionately longer than is usual in *C. imbricata*." Stebbing (1900) remarks on the difference in the anterior margin of the first peraeon segment of the ovigerous females figured by Schioedte and Meinert; the Danish authors show this margin as conspicuously bisinuate in the female figured by them as *Ceratothoa trigonocephala* and nearly straight in the female they designate *C. banksii*. In their figures of the males of the two species, however, the condition

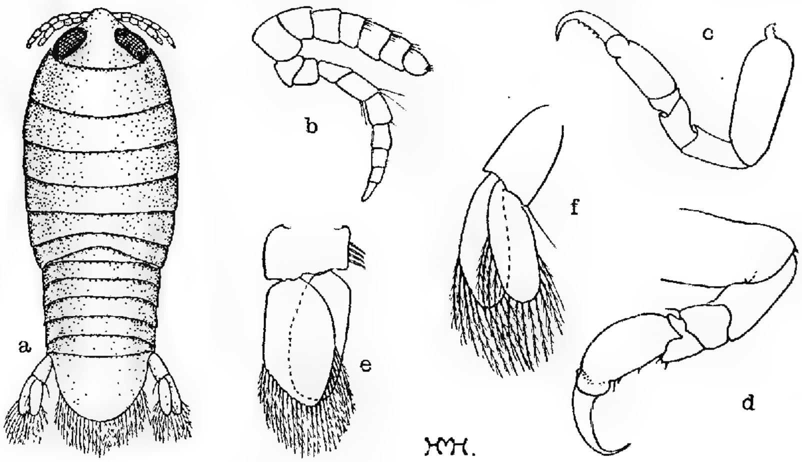

Fig. 16.

Codonophilus imbricatus, juvenile (Haswell's type specimen of *C. argus)*: *a*, dorsal view (13 diam.); *b*, antennae (39 diam.); *c* and *d*, first and sixth peraeopods (29 diam.); *e*, second pleopod (39 diam.); *f*, uropod (39 diam.).

appears to be reversed. In 1910 Stebbing definitely sinks *Cymothoa trigonocephala*, Leach, in the synonymy of *Meinertia imbricata*, and notes that probably *Ceratothoa trigonocephala* of Schioedte and Meinert is also a synonym. The variability of the Australian specimens leaves one in no doubt concerning this last reckoning.

Advanced young taken from the brood-pouch of a female are 4 mm. to 4·6 mm. in length, and differ from the adult in having the form symmetrical, the eyes large and conspicuous, the antero-lateral angles of the first peraeon segment scarcely produced, and the last peraeon segment short. Also, the inner edge of the dactylus of the anterior peraeopods is dentate, the seventh pair of peraeopods is not developed, the telson is fringed with long, delicately plumose hairs, and the rami of the uropods are suboval in shape and fringed with long plumose hairs. Schioedte and Meinert give the lengths of the young of the first and second stage as 3·5 mm. and 3·6 mm., respectively, under the name *Ceratothoa trigonocephala*, and as 4·2 mm. and 5 mm. under the name *C. banksii*.

The type specimen of *Codonophilus argus*, Hasw. (fig. 16), is 4 mm. in length ("5/32 in.") and is identical with advanced brood young of *Meinertia imbricata*. Haswell evidently made a superficial examination of the specimen upon which he founded his genus, for he states that the pleon has the "Terminal segment scale-like, acuminate," and that the uropods are "uniramous . . . Ramus . . . falciform with a few scattered cilia." When the type specimen is lifted out of the alcohol in which it is preserved and examined under the microscope, the wet, fringing, plumose hairs of the uropods and apical part of the transparent telson tend to converge to a point (like a wet camel-hair brush), and there is little doubt that this conveyed the impression that the telson and uropods were apically acute. Further, when the type was first examined by me the endopod of each uropod was closely overlying the exopod, and the matting of the marginal hairs held the two branches thus superimposed, producing the "uniramous" appearance; the "few scattered cilia" were evidently some projecting ends of the plumes of the fringing hairs. This specimen is of importance, as it necessitates the sinking of the generic name *Meinertia*, and the above rather obvious explanation is given because it is felt that it may be suspected that the example is incorrectly labelled as Haswell's type. There is, however, no doubt on that score. Haswell figures the maxilliped and the ischium, merus, carpus, propodus, and dactylus of the right peraeopod of the first pair; when first now examined the type had only these parts missing, the basos of the first peraeopod of the right side being still attached. I have removed, stained, and mounted the parts here illustrated, and also the first and second maxillae. It is noted on the type label that the example was taken "from *Crambessa mosaica*, in Port Jackson, New South Wales."

It is well to recall here that Richardson[10] remarks that *Aegathoa* of Dana "perhaps represents the young of *Livoneca*. The figure given by Schioedte and Meinert of the young female of *Livoneca redmanni* does not apparently differ from *Aegathoa oculata* (Say). I have not suppressed the genus, however, because I could not be positive of the identity of these forms."

OUROZEUKTES, Milne Edwards.

Ourozeuktes, M. Edw., Hist. Nat. Crust., iii., 1840, p. 275.

Urozeuctes, Sch. and Mein., Naturh. Tidsskr., (3) xiv., 1884, p. 404.

Basal half of cephalon immersed in first peraeon segment. Bases of antennae widely separated; first pair a little compressed. First peraeon segment medianly longer than any of the others. Coxal plates thick and subpendulous. Last four pairs of peraeopods successively increasing in length backwards. Pleon unisegmentate, moderately immersed in peraeon.

As noted by Milne Edwards, in the young stages *Ourozeuktes* is similar to the juveniles of other Cymothoidae; the adult female, however, is strikingly distinguished from all other members of the family by the following characters:—The dactyli of the peraeopods are rather small; the basos and ischium of the last four pairs are expanded, on the lower edge, in the form of a lamella furnished with blood vessels. The segments of the pleon, excepting at the extreme lateral portions, are solidly coalesced, but the suture lines are distinct. The telson is submembranaceous; both the telson and the pleopods are supplied with large blood vessels. The exopods of the first pair of pleopods are much enlarged, overlapping below, and reaching almost to, or a little beyond, the level of the apex of the telson, while their lateral parts are thickened and are recurved over the sides of the pleon; the lamellar expansion of the protopod of the second to fifth pleopods is very well developed.

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(10) Rich., Bull. U.S. Nat. Mus., liv., 1905, p. 216.

OUROZEUKTES OWENII, Milne Edwards.

Ouroseuktes owenii, M. Edw., Hist. Nat. Crust., iii., 1840, p. 276, pl. xxxiii., fig. 8; Heller, Reise der Novara. Crust., 1868, p. 148; Hasw., Cat. Austr. Crust., 1882, p. 283; Lucas, Bull. Soc. ent. Franc., v. 1885, p. lviii.; Jennings, Journ. Linn. Soc., xxv., 1896, p. 329, pls. xiii., xiv.

Ouroseuktes pyriformis, Hasw., *loc. cit.*, p. 283.

Urozeuctes owenii, Gerstaecker, Bronn's Thier-Reichs, Band. v., Abth. 2, pl. viii., fig. 20 (1881), and pl. xxvi., fig. 1 (1883); Sch. and Mein., Naturh. Tidsskr., (3) xiv. (1884), p. 405, pl. xviii., figs. 5-7.

Urozeuctes monacanthini, Sch. and Mein., *loc. cit.*, p. 407, pl. xviii., figs. 8, 9.

Urozeuctes caudatus, Sch. and Mein., *loc. cit.*, p. 411, pl. xviii., figs. 11, 12.

♀. Ovigerous. Form broadly obovate. Cephalon suborbiculate, much wider than long and with anterior margin emarginate. Eyes distinct, rather small, situate laterally. First antennae stouter than second; composed of seven articles, the first three of which are indistinctly separated: first article as wide, and more than half as long, as second, which is very large, nearly as long as the three terminal articles together; second antennae nine-jointed, the last three

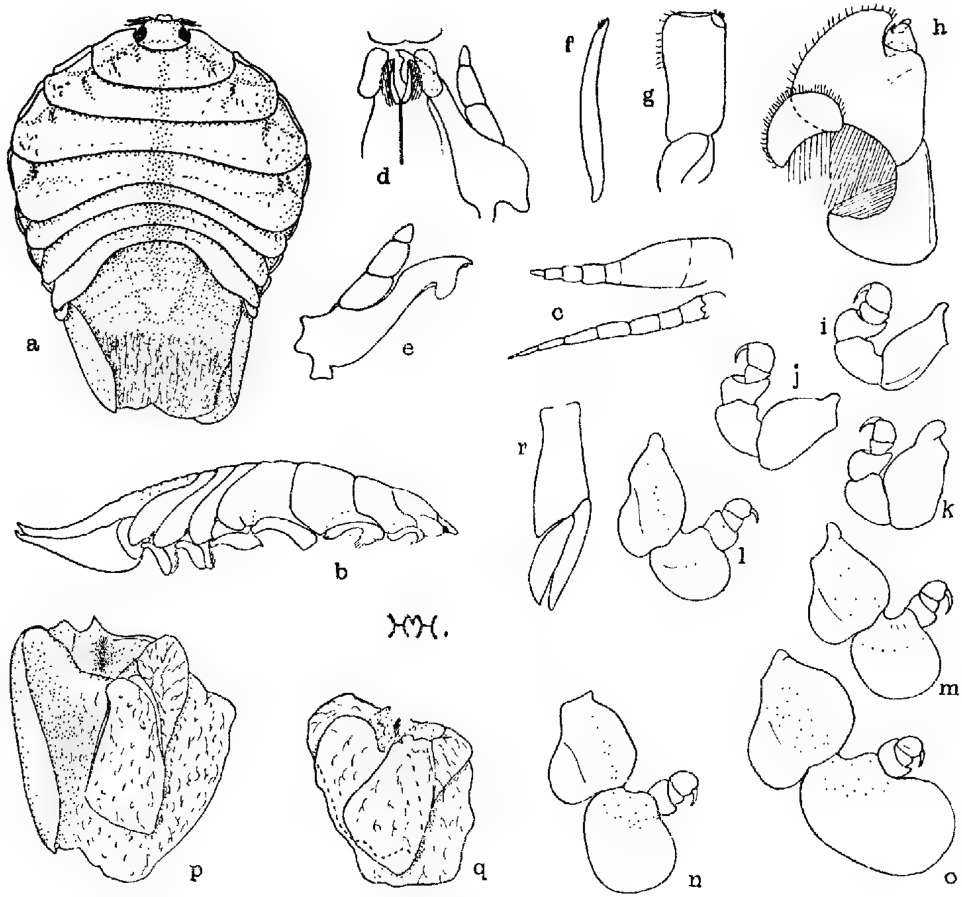


Fig. 17.

Ouroseuktes owenii. Ovigerous female: *a* and *b*, dorsal and lateral views (1⅓ diam.); *c*, antennae (8 diam.); *d*, mandible of left side, labium, and margin of labrum (8 diam.); *e*, mandible (8 diam.); *f* and *g*, first and second maxillae (8 diam.); *h*, maxilliped (7 diam.); *i* to *o*, first to seventh peraeopods (2 diam.); *p* and *q*, ventral view of first and third pleopods (2 diam.); *r*, uropod (3½ diam.).

articles reaching beyond apex of first antennae. Labrum visible in dorsal view, emarginate. Mandibles tapering towards distal end, which is directed inwards and is apically acute; below the extreme apex is a tiny, keen-edged lobe which, like the remainder of the cutting edge, is strongly chitinized; inner margin behind cutting edge produced into a thin, prominent lobe. Palp stout, the first article nearly as long as second and third together; third article short. First maxillae styliform, with the strongly chitinized, toothed apex lying in the emargination of the labrum, slightly behind the apices of the mandibles. Second maxillae wide, transversely curved, somewhat obscurely bilobed, the inner lobe small, with one or two spines. Peraeon widest at third and fourth segments; antero-lateral angles of first segment acutely rounded, reaching to level of middle of length of eyes; first four segments impressed and rugose laterally, and with antero-lateral portions tumid; each of last three segments shorter than any of others. Coxal plates of second and third segments reaching back to the postero-lateral angles of their segments; remaining plates not reaching to this level. First pleon segment partly concealed beneath last peraeon segment, with lateral parts free, each produced into a small lobe, which overlies the basal part of the exopod of the first pleopod, and reaches back to the level of the posterior angles of the third segment; a small lateral portion of each of the second to fifth segments free, lobular. Uropods reaching to apex of pleon; protopod as long as, or longer than, rami; branches of the uropod of one side apically rounded, of the other acute; endopod wider, and longer or shorter, than exopod. Peraeopods each with propodus and dactylus short; lamellae of basos and ischium of last four pairs successively increasing in size backwards; basos of seventh pair (with lamella) as wide as long; lamella of ischium of these peraeopods very large, much longer than basos. Pleopods of second to fifth pairs successively decreasing in size backwards; endopod of first pair much shorter and very much narrower than exopod, that of second and third pairs a little shorter and much narrower than exopod; that of fourth and fifth pairs as long as, but much narrower than exopod; endopod of all pleopods obliquely subtruncate posteriorly; lamellar expansion of protopod of second to fifth pleopods greatly developed and similar in structure to the endo- and exopod; lamella of the last two pairs almost as long as exopod.

Colour: Whitish, with a smoky median stripe on peraeon and anterior part of pleon, and with telson black.

Length, 43 mm.

♂. Form symmetrical, narrowly obovate, three times as long as greatest width. Cephalon large, wider than long, with anterior margin emarginate. Eyes large and conspicuous. First antennae stouter than second, composed of eight articles, the basal two of which are not conspicuously larger than the others. Second antennae composed of nine articles. Mandible much as in adult female, but with palp setose near apex. Second maxillae slender, with a single hooked spine at apex of terminal article. First segment of peraeon longer than any of the others. Pleon with six distinct segments; telsonic segment posteriorly rounded and fringed with hairs. Endopod of uropods only half as long as exopod, sub-oval in shape; exopod elongate, rather narrow. Peraeopods not very stout and not expanded; each with propodus and dactylus long; propodus of first pair with three spines and carpus with one spine, on inner edge; merus with a spine at outer distal angle and dactylus serrated on inner edge. Pleopods each with two lamelliform rami; male appendage of second pair longer than endopod.

Colour: Yellow, dotted with chromatophores on cephalon, peraeon and first five segments of pleon; more abundantly pigmented chromatophores form a dark median stripe, and another on each side. Telson transparent. Protopod and exopod of uropods with a line of chromatophores along outer edges.

Length, 7 mm.

Loc.—New South Wales: Parramatta River, from *Cantherines granulatus,* Port Jackson, from *Cantherines hippocrepis,* etc., and Georges River, Botany Bay (Austr. Mus. Coll.), Laurieton, from *Cantherines trachylepis* (D. G. Stead), Maroubra Beach, from *Cantherines hippocrepis* (G. P. Whitley), Kurnell, Botany Bay, from *Cantherines* sp. (W. A. Rainbow), Port Hacking, from *Cantherines* sp. (Miss M. Henry). South Australia: Gulf St. Vincent, from *Cantherines guntheri* (A. E. Waterman), from *Cantherines hippocrepis* (F. K. Boase, etc., and "from a shark" (?) (Dr. Cleland), Whyalla, from *Cantherines setosus* (Dr. Souter), Port Willunga, from *Cantherines setosus* (S. Howe), Largs Bay, from *Cantherines* sp. (A. E. Andrew). Western Australia: Bunbury, from *Cantherines* sp. (W. J. Kimber), Cottesloe and Swan River, from leatherjackets, and Fremantle (W. Austr. Mus. Coll.).

Hab.—South-eastern, southern, and south-western coasts of Australia, Kerguelen (*fide* Jennings).

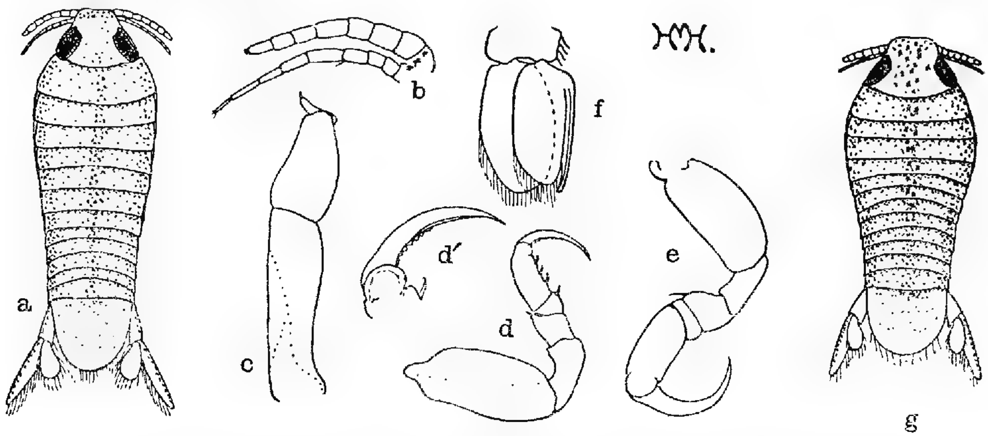


Fig. 18.

Ouroseuktes owenii. Male: *a,* dorsal view (7½ diam.); *b,* antennae (20 diam.); *c,* maxilliped (40 diam.); *d* and *e,* first and seventh peraeopods (20 diam.); *d′,* dactylus of first peraeopod (40 diam.); *f,* second pleopod (20 diam.). *g,* Dorsal view of juvenile from marsupium (25 diam.).

Seven males, one of which is described above, were found with a female collected in South Australia. In this female the marsupium is not completely developed; the males were nestling under the basal joints of the peraeopods, outside the oostegites. It is improbable that these males have attained their maximum size and development, and it may be that, as suggested by Jennings, protandrous hermaphroditism occurs in this genus. Males 5 to 8 mm. in length were found under the legs of other females in which the oostegites are not developed.

Several females have juveniles in the brood pouch corresponding to the "pullus stadii primi" described by Schioedte and Meinert under their *Urozuectes monacanthini;* these average 2·7 mm. in length and 1·1 mm. in width, and have the usual characters of immature Cymothoids (fig. 18 *g*). The modifications peculiar to *Ouroseuktes* take place during growth.

More than fifty females of various sizes are before me; the largest is 52 mm. in length. In an example 11 mm. in length (fig. 19, *a*) the cephalon is relatively larger than in more advanced specimens, the antennae and mouth parts are still much as in the male, and the peraeon is not much widened. The propodus and dactylus of the peraeopods are relatively shorter than in the brood young, but

much longer than in large females; the foliaceous expansions of the last three pairs are slightly developed. The pleon segments are coalesced and the telson is smooth and membranaceous; the pleopods and telson are not richly supplied with blood-vessels, but the exopods of the first pleopods reach to the end of the pleon.

In very large ovigerous females the peraeon is usually relatively wider than in smaller egg-bearing specimens. The pleon of the adult female (when perfect) is subtriangular in shape, somewhat variable in relative length, tapers to the narrowly rounded or narrowly subtruncate apex, and has the lateral margins downbent; the apical part of the telson is, however, very often damaged and irregular. The cephalon is more elongate in some specimens than in others, and in one instance is almost as long as its basal width. A sooty, median stripe is often present on the peraeon, but some examples (during life) are white, without pigmentation excepting on the telson; in others the peraeon is lightly sprinkled with tiny chromatophores.

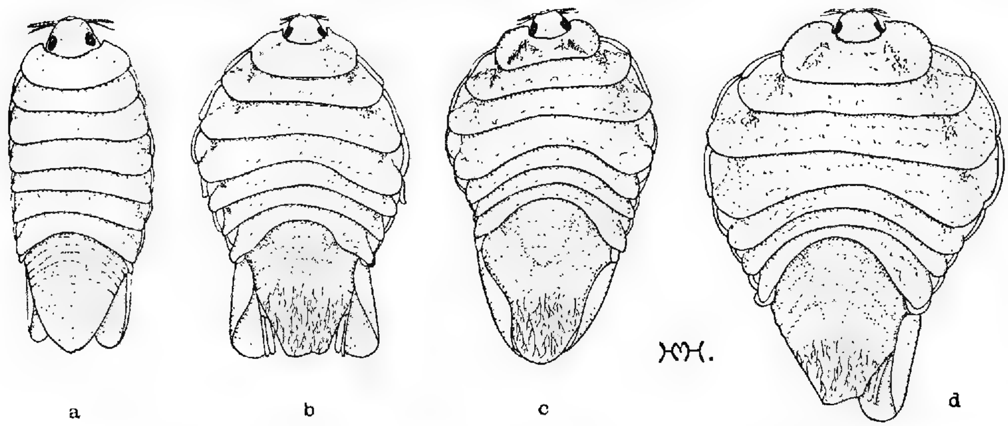


Fig. 19.

Ouroseuktes owenii. *a*, Young female (3 and three-fifths diam.), *b* and *c*, Ovigerous females (1⅗ diam. and nat. size). *d*, Ovigerous female, syntype of *O. pyriformis*, Haswell (nat. size).

The characters quoted by Schioedte and Meinert as separating their *O. monacanthini* and *O. caudatus* from *O. owenii* are unstable; the Danish authors founded the first species upon a single specimen 24 mm. in length from Sydney, and the second upon a single, badly preserved South Australian specimen of the same length. It may be remarked, however, that the pleon of the type of *O. monacanthini* is apparently relatively smaller than in any of the specimens now examined. Haswell applied the provisional name *O. pyriformis* to two large females (fig. 19, *d*), which only differ from the type figure of *O. owenii* in having the telson more perfect (not abbreviated) and the peraeon relatively wider anteriorly.

Considering that *Ouroseuktes* was described eighty-five years ago, it appears, strangely enough, that no detailed note has been published concerning its habits. Milne Edwards' female was without data ("Patrie inconnue"), but Heller records the species from Sydney, and Lucas, in 1885, mentions a specimen taken "dans la poche branchiale d'un *Monacanthus melanurus*, Rich.," (? *M. megalourus*, Rich.) from Port Jackson. A. Gerstaecker copies M. Edwards' figure in the Thier-Reichs, and adds an illustration of a young stage. Schioedte and Meinert describe the beast under three different names and furnish the information that their *O. monacanthini* was taken "'e cavitate

abdominali' (?) Monacanthini vittati promptum est." Haswell gives a translation of M. Edwards' specific description, and adds a short diagnosis of the pear-shaped form which he considers distinct. Jennings describes a female said to have been obtained by a sailor "at sea near Kerguelen Island," and furnishes figures (some of which are not very accurate) of the animal and its parts. Finally, occasional casual references to the genus have appeared in literature.

Jennings' conjectures as to the habit of *Ourozeuktes* are entirely wrong; he decided that the "hinder limbs are very efficient swimming organs" and that the adult animal "has the power of living freely, though doubtless parasitic at times." As a matter of fact, it may be almost claimed that *Ourozeuktes* is an endoparasite, for, like *Ichthyoxenus,* it burrows into the sides of fishes, is for the greater part concealed within the body thereof and, when adult, is unable to leave its host. From the material in hand it would appear that leather-jackets (Monacanthidae) are almost always chosen; according to the reports of fishermen and others, *Ourozeuktes* is anything but rare, and is found only in fishes of this family. The majority of specimens in our collections have been removed from their hosts, but it has been possible to examine some leather-jackets with the parasites *in situ,* and the following observations result:—The crustacean enters the body cavity of its host some distance behind and below the pectoral fin (sometimes very close to the anus), but is never completely concealed, the posterior parts of the telson and pleopods protruding through the entrance slit (pls. xxxvi., xxxvii.). It lies always with the venter pressing against the intestines of the host, and usually bores forwards and slightly inwards, so that in comparatively small fishes the cephalon reaches the neighbourhood of the liver of the host. It rests in a pouch of membrane formed by reaction of the injured tissues, and, normally, the only opening in this pouch is the slit through which the hinder parts of the parasite protrude. The membrane is usually whitish, but in two instances is closely dotted with black chromatophores; it is for the greater part thin and fragile, but the anterior end of the cul-de-sac —the "feeding area"—is subjected to laceration by the mandibles, maxillae, and anterior dactyli, and is rugose and thickened; the mouth parts are sometimes scarcely removed from the liver of the fish by more than the thickness of the feeding area of the enveloping membrane. The entrance slit is very much narrower than the width of the parasite (even when the last-named is of moderate size), and it is thus totally impossible for the established female to leave its host. In small fishes the parasite is jammed between the two halves of the shoulder girdle, a condition which doubtless causes the crustacean to assume a pyriform shape as it increases in size (fig. 19, *d*). In a specimen of one of our large species of leatherjacket *(Cantherines hippocrepis)* an *Ourozeuktes* has entered the body cavity close to the vent, and has bored almost directly upwards and inwards, so that its mouth parts have almost pierced the swim-bladder of the fish; this parasite is nearly symmetrical.

The curiously expanded posterior limbs evidently assist the parasite to maintain its position, these legs being firmly pressed outwards against the soft enclosing membrane; the dactyli of the anterior peraeopods are hooked into the walls of the cavity near the feeding area. The large curved exopods of the first pleopods are obviously modified for the purpose of holding open the aperture in the skin of the fish (pl. xxxvi.); these lateral branches, and the pleon, together form a sort of funnel in which the endopod of the first pleopods and the three lamellae of each of the other pleopods are protected. The maxillipeds of the ovigerous female are lamellar in character and, as in other members of the family, are no doubt utilised to promote a flow of water through the marsupium

for the aeration of the eggs and young; in all probability the lamellar expansions of the posterior peraeopods also assist respiration.

It sometimes happens that a fish shelters two large *Ouroeuktes*, one on each side; I have before me a specimen of *Cantherines granulatus*, 135 mm. in length, in such case (pls. xxxvi., xxxvii.). The parasite on the left side is 26 mm. in length and 16 mm. in width (fig. 19, *b*), and the entrance slit in the skin of the fish is 12 mm. in length. This example is decidedly interesting, for its young are in progress of leaving the maternal brood pouch; these juveniles are, on the average, 3 mm. in length and 1·2 mm. in width, being thus larger than the "pullus stadii primi" of Schioedte and Meinert. Many young still remain in the marsupium, some are clinging to the pleopods of the mother, and others have emerged and firmly attached themselves to the skin of the fish (pl. xxxvi.). The example on the right side is also of some interest (pl. xxxvii.). It appears that in its efforts to penetrate further forward into the body of its host this specimen has allowed the exopod of the first pleopod of the right side to slip inside the body cavity of the fish. This has resulted in the rupturing of the lower side of the membrane sac and also of the wall of the intestine, so that the crustacean is partly embedded in a mass of food material from the gut of the fish; the posterior legs of the right side are extended outwards and the dactyli are hooked into the gut, but the hind legs of the other side are directed backwards with the outer faces of the lamellae pressing against the undamaged side of the sac. The anterior end of the sac is as in normal cases. The dotted outline on the photograph shows the relative size and position of this individual, which is 28 mm. in length and 16 mm. in width; the entrance slit is only 8 mm. wide.

Leatherjackets infested with *Ouroeuktes* sometimes appear thin and ill-nourished, and their flesh is flabby. The intestines and the anus often become displaced, the last-named moving a little to one side of the mid-line of the venter (pl. xxxvi.). I have removed one or two living female *Ouroeuktes* from their hosts; the parasites were singularly helpless when free and were quite unable to swim; when placed in water they sank to the bottom and gropingly waved their limbs, but otherwise remained motionless. They proved remarkably tenacious of life and lived for a considerable period out of water.

ADDENDA TO PART I.

Argathona similis, Richardson.

A male of this species recently received from Mr. Glauert, of the Western Australian Museum, differs from the two females previously examined, and from the type male, in having the eyes larger and less widely separated, the narrowest interocular space being equal to one-sixth of the total width of the cephalon. The flagellum of the second antennae reaches to the middle of the length of the fifth peraeon segment. The palp of the maxillipeds is four-jointed. The male appendage of the second pleopods reaches to the level of the apex of the endopod. This example is 14 mm. in length and was taken from a nannygai *(Trachichthodes affinis)* caught by Mr. G. A. Goss at Fremantle, Western Australia.

Also, two gorged specimens, a male and female, were collected a short time ago by Mr. Stan. Howe at Port Willunga, South Australia; these are 17 mm. and 19 mm. in length, respectively, and were found clinging near the anus of a parrot fish *(Pseudolabrus)*. During life they were whitish dorsally, spotted with brown. The eyes of both examples are widely separated and the palp of the maxillipeds is four-jointed. In the male the flagellum of the second antennae

reaches back to the apex of the last coxal plates; in the female it attains to the level of the hinder margin of the sixth peraeon segment. The male appendage of the second pleopods is as in the male from Western Australia.

Aega cyclops, Haswell.

Included in a batch of material just received from Mr. Melbourne Ward, of Sydney, is a small *Aega* which should evidently be referred to this species. This example, which is a male, agrees with Haswell's type in the form of the frontal lamina, antennae, peraeopods, maxillipeds, uropods, etc. The body, however, is slightly more slender, and the head is relatively smaller, with the eyes smaller and meeting for a much shorter distance (only three facets in contact); also, a lesser part of the first pleon segment is covered by the seventh peraeon segment, so that the last coxal plates reach only to the hinder angles of that pleon segment.

The flagellum of the first antennae consists of seven articles and a terminal style, that of the second pair of twelve articles and a style. The telsonic

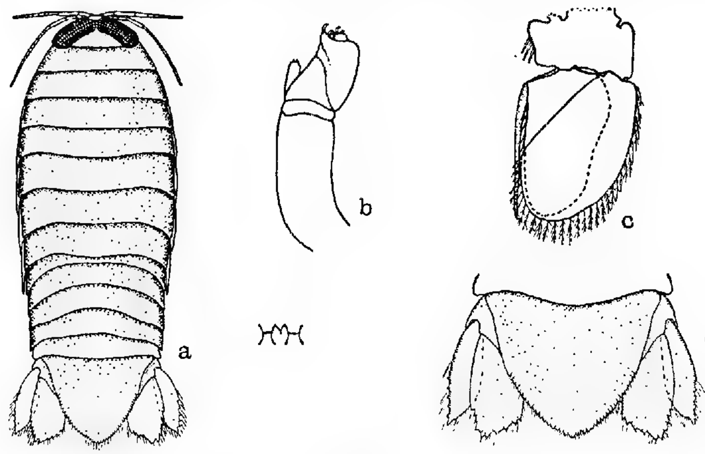


Fig. 20.

Aega cyclops, male: *a*, dorsal view ($5\frac{1}{2}$ diam.); *b*, maxilliped (38 diam.) *c*, second pleopod (15 diam.); *d*, telsonic segment and uropods (9 diam).

segment is roundly subtriangular in shape, with the posterior half of the lateral margins finely serrate.

Length, 10 mm.

Loc.—New South Wales: South-east of Sydney, in "New Zealand area," 75 faths. (M. Ward).

As previously noted, the true shape of the telson cannot be ascertained from an examination of the type; *A. meinerti*, Miers, is apparently a closely allied species which has the telson apically truncate.

Rocinela sila, Hale.

A male dredged this year in Gulf St. Vincent closely resembles the holotype. The flagellum of the first antennae consists of five articles and a terminal style, that of the second antennae of eleven articles and a style. The male appendage of the second pleopods is nearly as long as the inner ramus. During life the colouration was as follows:—Cephalon margined with white, with a submarginal black line and with a white spot alongside intero-posterior angles

of eyes. Eyes black. Dorsum of peraeon and pleon with crowded brown reticulations (so that the ground colour appears pale brown); with a pair of closely approximated dark stripes on mid-line of cephalon, peraeon, and first five pleon segments. On each side of these median lines are two other longitudinal stripes, the inner of which extends from the anterior margin of peraeon to basal part of telson, and the outer occupies the whole length of peraeon. Underside subhyaline. Peraeopods and antennae subhyaline, marked with a few dark chromatophores; coxal plates and basal half of uropods orange; telson, uropods, and coxal plates marked with black as previously described.

Loc.—South Australia: five miles off Semaphore, 5 faths. (H. M. Hale).

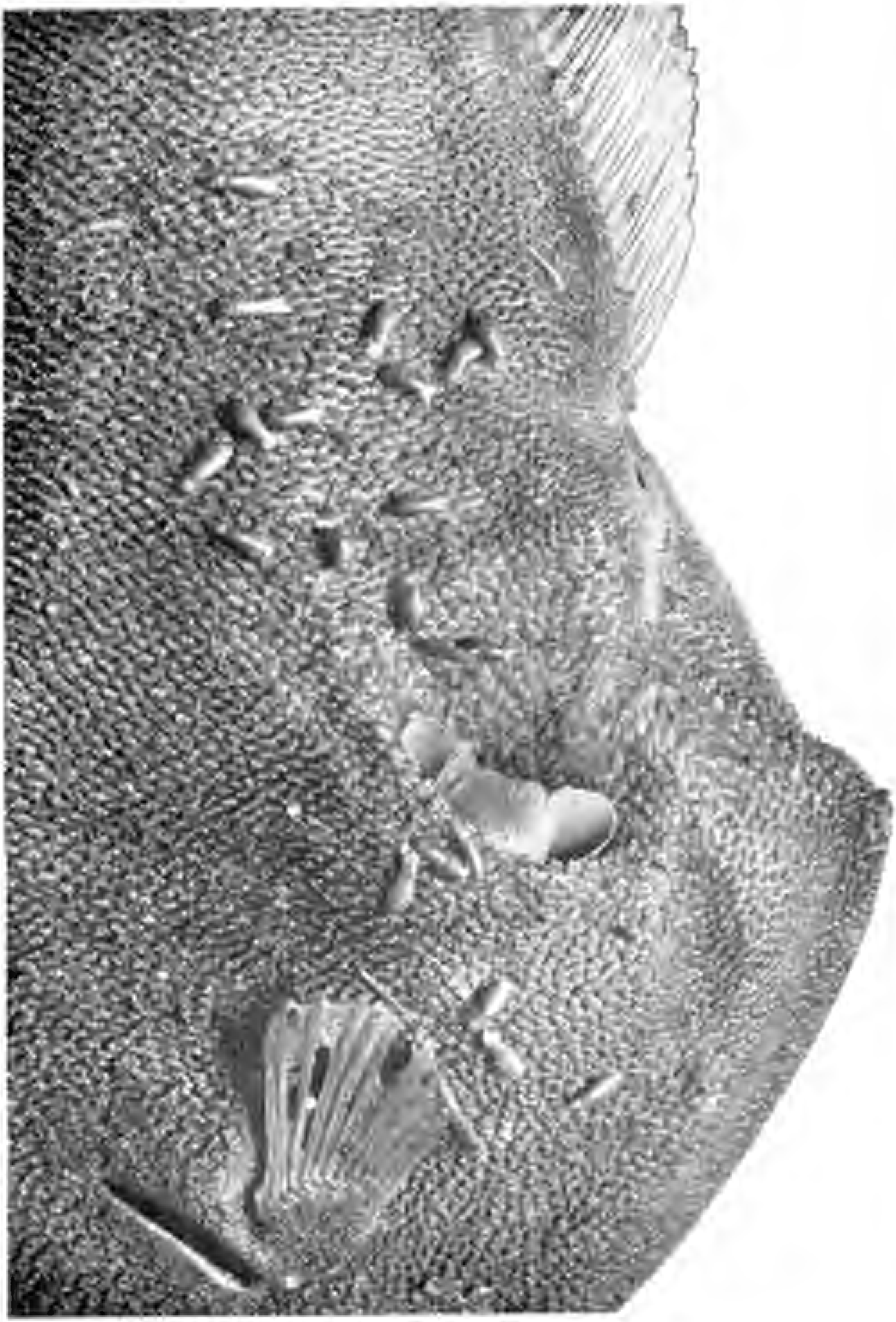
DESCRIPTION OF PLATES XXXVI. AND XXXVII.

Plate XXXVI.

Left side of a leatherjacket *(Cantherines granulatus)* showing adult female *Ourozeuktes* ensconced in the body cavity, and juveniles (which have recently vacated the brood-pouch of the crustacean) clinging to the skin. Note how the protruding exopods of the first pleopods of the parasite hold open the entrance slit in the skin of the fish. (3 diam.)

Plate XXXVII.

Right side of the same fish (see pl. xxxvi.), which is burdened with a female *Ourozeuktes* in each side of the body cavity; the dotted line shows the relative size of the parasite. (3 diam.)



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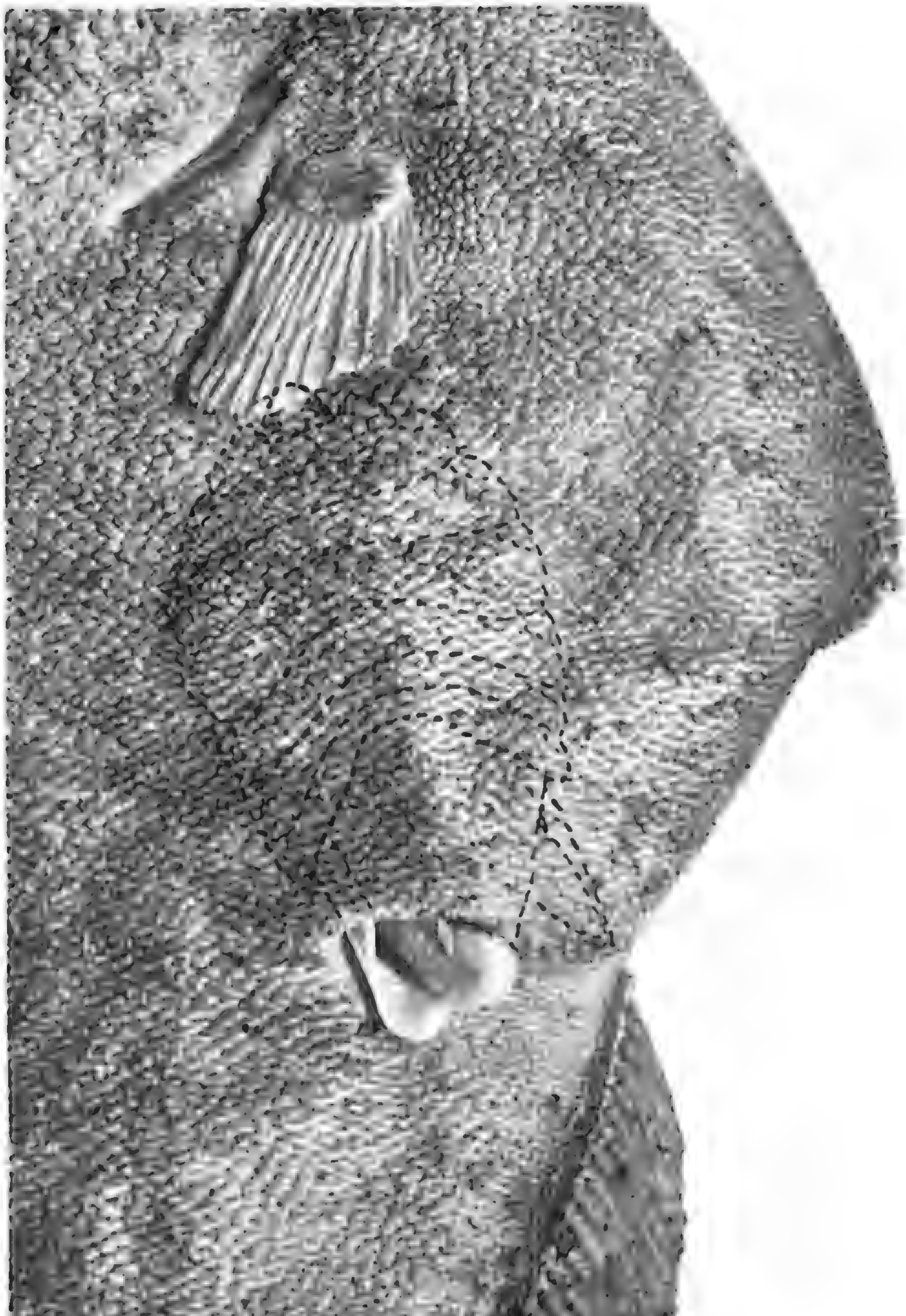

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REMARKS ON THE PROPRIETY OF INTRODUCING INSECTS TO CONTROL PRICKLY PEAR IN AUSTRALIA.

By Professor T. Harvey Johnston, University, Adelaide.

[Read August 12, 1926.]

Australia has suffered severely as a result of the introduction of certain plants and animals which have found conditions so favourable in this continent that they have increased to such an extent as to become pests. One might mention only a few—the rabbit, rat, mouse, and fox; various parasites of stock; the sparrow and starling; many insects; prickly pear and many other plants which have become nuisances through occupying land and rendering it unfit for useful production except at great expense. In view of these facts, the public are apt to view with disfavour, if not with hostility, attempts to introduce any kind of organism, even for the purpose of controlling pests. The important question to be answered is whether the particular organisms will attack only the pest against which it is proposed to be liberated, and supposing that the pest become controlled, what will happen to the importation? If the new organism is restricted to the pest for its food supply, then the eradication of the pest must necessarily lead to the destruction of all plants or animals whose dietary is confined to such pest species.

The natural way to control any animal or plant pest is to utilise its natural enemies, which may be either plants or animals. Amongst the plant organisms are included more especially fungi and bacteria, while amongst those belonging to the animal kingdom the chief are insects, though in certain cases vertebrates may be concerned. Such natural enemies may be predators or parasites. Since the various controlling agents may themselves be preyed on or parasitised by other organisms which control them, it is essential that any which are to be utilised against a pest, must themselves be maintained free from controlling agents, so that they may be able to exert their influence as fully as climatic conditions will allow. Besides, the habits of the organisms which it is proposed to introduce as a means for pest control must be known, so that unnecessary risks of introducing any which may themselves become a nuisance, may not be incurred. Hence, general feeders must be rigidly excluded, and only such organisms utilised as are known to be restricted in their dietary to the particular pest species, or to closely related members of the group or family to which the pest belongs. Thus in connection with the utilisation of biological agents against the prickly pear (*Opuntia* spp.) only such should be employed as are known to be restricted either to one or more species of *Opuntia*, or at least to members of the cactus family to which all prickly pear plants belong.

To Mr. Henry Tryon, formerly Government Entomologist of Queensland, belongs the credit for having made the first attempt to control the pest by entomological means. In 1903 he endeavoured to obtain specimens of a wild cochineal insect from Ceylon where it had played an important role in this connection, and though a few insects reached Queensland alive, they failed to become established. From what we now know, the reason for the lack of success was almost certainly the inability of that particular species to attack the common pest pear (*O. inermis*) presented to it as a food supply, but it was not until 1913 that its very restricted feeding habit was especially emphasised by Tryon and myself.

In 1911 the Queensland Government appointed a Board of Scientific Advice on Prickly Pear Destruction, which recommended that a small Travelling Commission should be appointed to visit those countries of the world where similar

plants occur either indigenously or in a naturalised state, in order to inquire whether there existed in such countries any natural enemies which might be introduced into Queensland to control the pest there. Mr. Tryon and the author of this paper were selected for that duty (1912-1914), which led us to explore, as well as circumstances permitted, India, Ceylon, South Africa, the Mediterranean littoral, North and South America, and the West Indies, a report to Parliament being published in 1914.

From Ceylon there were forwarded by this Commission, early in 1913, consignments of a "wild" (*i.e.*, not the true) cochineal, *Dactylopius indicus*, Green, together with a supply of its food plant, *Opuntia vulgaris (monacantha)*, and a cochineal "nursery" was established near Colombo from which further supplies were sent subsequently. As a result of the field experience gained, it was pointed out that this insect was very restricted in its dietary; that it should control *O. vulgaris*, which was then widely distributed in the moister areas of Queensland; that it was unlikely to attack any of the other kinds of *Opuntia* naturalised there; that it would not attack any other kind of plant; and that it would probably be preyed upon by a certain Australian ladybird beetle, *Cryptolaemus montrouzieri*. All of these predictions were verified, and the particular kind of prickly pear was practically exterminated within a few years in all those areas in which the insect was liberated against it. A similar destructive result was brought about in South Africa, due to the activity of material collected in Northern India and handed over by the Commission to the local entomological authorities.

As a result of the experience gained during its wide travels in prickly pear regions, the Commission recommended that certain fungi and insects should be introduced from North and South America, and actually imported certain species from those continents. It was also recognised that cactus insects were not exercising their maximum degree of destructiveness in countries in which cacti were indigenous because of the amount of parasitism (and consequent control) to which such insects were subjected. The outbreak of war prevented the biological recommendations of the Commission from being adopted, and it was not until 1920 that the writer was appointed by the Commonwealth Government, at the request of the Bureau of Science and Industry, to undertake the work of introducing the various insects and fungi, under the general control of the Commonwealth Prickly Pear Board. Opportunity was afforded to revisit the prickly pear regions of North and South America (1920-1921) and to gain additional advice and experience regarding the proposed importations. Arrangements were made for their collection by senior members of the biological staff located in Southern U.S.A. and in Argentina, and for the necessary transportation to Australia. The chief American centres for the investigation were in Florida and South-eastern Texas, where work was carried on during winter and summer respectively for several years, while the South American work was centred chiefly at Tucuman, in North-western Argentina. Material was also collected in California, Arizona, and Mexico. The general plan of campaign and the work of the various insects have already been detailed (Johnston, 1923; Alexander, 1925).

It was pointed out by the Travelling Commission, after their extensive inquiries in prickly pear countries, that many cactus insects were very specialised, and that the association between them and the plants was extremely close in some cases, *e.g.*, the various cochineal insects (*Dactylopius* spp.), some of which were restricted to one or two species of cacti, while others were able to feed on several different species. Many of the other insects whose introduction was recommended, had been specially studied by highly qualified economic entomologists in U.S.A., who placed their experience and advice at the disposal of the Commission. Advantage was also taken to consult the comprehensive lists compiled by the Division of Entomology of the Department of Agriculture, U.S.A., indicating

the food habits of the various insects collected, and in addition, the American experts in each branch of entomology to which the particular insects belonged, were approached in regard to food habits and the possible danger arising from the proposed introductions, and it was only when these authorities pronounced favourably that such insects were listed amongst those to be recommended. All species were rejected from the list of proposed consignments when it was ascertained that they were not invariably restricted to cacti for their food. It was further pointed out by the Commission that it knew of no case of any destructive insect of exotic origin, accidentally or ignorantly introduced into any country whose destructiveness, evinced in its new home, could not have been anticipated from a full consideration of its habits in its country of origin.

One of the members of the Commission responsible for the above statements was Mr. Henry Tryon, who for so long ably filled the office of Government Entomologist and Plant Pathologist for Queensland, and who has a very comprehensive knowledge of economic entomology. Such statements as those quoted above must therefore be regarded as considered judgments by one well qualified to make them. The other member was the writer of the present paper, who revisited the prickly pear regions of America in 1920, and his further experience and observations confirmed what was written in 1914.

The authors of the Bulletin on "The Principal Cactus Insects of the United States" (1912, p. 12) mentioned that "324 species of insects are known to be associated with the cactus plant. These divide themselves naturally into five categories, as follows:—Species injuring the plant, 92; parasites of injurious species, 28; scavengers, 73; flower visitors, 40; species only incidentally associated with the plant, 91." Only a very small proportion of these has been introduced into Australia, the second, fourth, and fifth groups having been eliminated from consideration; and of the remaining two not more than 20 were being bred in the Prickly Pear Board's laboratories when the writer relinquished control, though a number of additional species had died out either through being unable to adapt themselves to any of the species of prickly pear naturalised in the Commonwealth, or through a failure to propagate under the conditions presented to them. None of those which had failed to become acclimatised (to February, 1923), other than *Asphondylia* and *Cactoblastis*, plays a very serious role in its native home as a primary attacking agent, though many of them are important scavengers capable of aggravating injuries produced by other agents. Unfortunately some very important insects, *e.g.*, *Mimorista*, which seemed likely to become established, have failed to breed in sufficient numbers and their ultimate naturalisation is still doubtful. Some insects known to be restricted to cacti were not introduced because the injuries caused by them were so slight that they had no appreciable effect on the growth of the plants attacked. All those which were being bred in the Board's laboratories belonged to the first group referred to in the "Cactus Insect Bulletin." No general feeder was utilised and no insect was introduced except such as had been definitely pronounced by the specialists in the particular group of insects to which each kind belonged.

Every species proposed to be utilised was also carefully considered by the two authors of the "Cactus Insect Bulletin" (Dr. Hunter and Mr. J. D. Mitchell), who were living at the time of the Travelling Commission's visit to U.S.A. in 1913, and the writer's second visit in 1920, and both still recommended their utilisation, while Dr. Hunter actually supervised the Board's work in U.S.A. since 1921. It should also be stated that the latter is one of the foremost American economic entomologists, is in charge of all the investigations regarding "southern field crops," *i.e.*, warm temperature and subtropical crops, including cotton and sugar-cane, and is, moreover, a member of the Federal Horticultural Board, a small administrative body which is in control of plant quarantine and regulates

all importations of plants and insects into U.S.A. Under his control are many laboratories with staffs of entomologists, as well as "field staffs." Hence a pronouncement by him on the subject must carry weight. Since cotton is perhaps the most important crop in the main prickly pear region of Texas, and will probably become the chief crop in the infested region in Australia, it might be mentioned that for many years cotton has been particularly studied in Texas as to its insect fauna, and entomologists are employed to inspect in a most detailed manner the cotton crops in certain districts in connection with the campaign against boll weevil and the pink boll worm; yet no cactus insect had been reported as attacking the cotton crop.

The late Mr. J. D. Mitchell, co-author of the "Cactus Insect Bulletin," was for many years a "field agent" of the Bureau of Entomology in that part of Texas where prickly pear is most abundant, and his field observations regarding its insect fauna were made between 1907 and 1910 while he was engaged on work in connection with field crop investigations under Dr. Hunter, hence the authoritative significance of the statements in the Bulletin relating to cactus insects in U.S.A. It might be mentioned that the Travelling Commission had the advantage of Mr. Mitchell's company during their work in Southern Texas in 1913.

Although very many bulletins relating to the insect fauna of various crops in U.S.A. have been issued by the Department of Agriculture, the writer is not aware of any of the cactus insects represented in the Australian introductions having been recorded in any of them as attacking such crops, while the host-plant and insect catalogue of the Bureau of Entomology, as mentioned by the Travelling Commission, did not indicate that such had been found.

Though the specialists in the entomological section of the U.S. National Museum were again consulted by the writer on his visit to U.S.A. in 1920, in reference to the safety of introducing the various species which were subsequently imported, in no case was a contrary opinion expressed, though, in regard to a certain group of beetles previously excluded *(Cactiphagus)*, the opinion was expressed that its members might also be utilised with safety, but since they were not prevalent in the localities where the Board's staff was engaged, and as the injuries caused by related insects were insignificant, no attempt was made to introduce them. Thanks to the kindness of Dr. Berger and Mr. Merrill, the entomological collection of the Florida Board of Horticulture was examined and the exclusive host relationship of the local cactus insects under review was indicated just as was shown by the large national collection in Washington D.C.

The Board's senior officer in U.S.A., Mr. J. C. Hamlin, who was previously inspector in the plant and insect quarantine branch of the Department of Agriculture, U.S.A., was engaged for two years—November, 1920, to November, 1922—in the prickly pear regions of the southern portion of the Republic, and his experience, related to me, confirmed the opinion expressed by the Travelling Commission.

It might be pointed out that the Cactaceae constitute an extremely well-defined family of plants, and with one or two possible exceptions (species of *Rhipsalis)* its members were originally confined to America, as also was its specialised insect fauna. It might also be mentioned by way of contrast from the Australian experience with prickly pear, that the investigation regarding cactus insects in U.S.A. had for its object a study of such insects with a view to their possible control, since Opuntias were being utilised to some extent as a subsidiary fodder for stock, whereas in Australia the aim is to propagate the insects in order to control the plant instead of controlling the insect in order to propagate the plant.

It is worthy of note that, with the exception of *Asphondylia*, the scavenging flies, and the scale insects, all the species represented amongst the primary enemies introduced into the Commonwealth belong to genera restricted to cacti, and in all

cases both the larva and adult (excepting the adult moths which, if they feed at all, feed on nectar or sugary solutions as other moths and butterflies do) depend on these plants for their food. The scavenging flies are not all restricted to rotting or injured cacti, as the Stratiomyiids will breed in other decomposing vegetation, but the species of Volucelline flies seem to be so restricted. However, none of these species has propagated in Australia, and local flies (Stratiomyiids, Ortalids, Syrphids and Drosophilids) are serving a similar purpose, though probably much less effectively.

Experience and observations regarding the behaviour of certain prickly pear insects outside of America may be of interest. The so-called Indian cochineal has been in India since 1795—130 years—and has not been recorded as attacking any kind of plant but *Opuntia monacantha*. Though introduced into the Cape Province and Natal in South Africa, and into Queensland in 1913, the species has failed to attack any kind of plant, including prickly pears, other than the species mentioned. Dr. White-Haney in 1913 found that it would not infest various economic plants presented to it at Dulacca (Western Queensland).

The "Cape cochineal" introduced into Cape Colony about ninety years ago has restricted its attention to *O. monacantha*, while the various kinds of cochineal insect introduced by me have shown preference for certain species of prickly pear rather than others (Johnston, 1923; Alexander, 1925).

The cactus Diaspid scale insects now occur in cultivated collections of cacti as well as in the field in many parts of the world, including New South Wales and Queensland, and have restricted their attention to members of the Cactaceae.

The two beetles, *Disonycha varicornis* and *Gerstaeckeria clathrata*, introduced into Queensland in 1921-22, maintained the same restricted host relationship as they showed in U.S.A., where they attack only the "cholla" type of prickly pear. In Australia these insects died out when the supply of appropriate cactus, sent across with them, was eaten out, they being unable to live on any of the main species naturalised in the Commonwealth.

It may be pointed out that in this continent, where such an immense mass of prickly pear is available for insect attack, apart from the occasional gnawing by grasshoppers, the plants do not suffer any infestation under normal conditions, and it is only when serious droughts are in progress that insects have been observed infesting such plants, and then they may attack in such numbers locally as to sicken the prickly pear. In other words, when most other vegetation is no longer available to supply the necessary plant juices, the *Opuntia*, which is able to maintain a considerable amount of succulence in spite of dry conditions, is called upon to provide the needs of such general feeders as the Rutherglen bug *(Nysius vinitor)* and an Aphis. This is mentioned as additional evidence regarding the restricted host relationship of cacti as far as insects are concerned, since even well-known general feeders rarely attack it in Australia.

The remarkable egg-laying habits of some of the cactus insects—*Melitara, Mimorista, Cactoblastis, Chelinidea, Gerstaeckeria*, and *Asphondylia*—all support the view that these moths, bugs, weevils, and midges are restricted in their dietary to cacti.

In view of the authoritative expressions of opinion by scientific men, including eminent economic entomologists and specialists, as well as the extensive observations and the negative evidence detailed in this article, the writer has no hesitation in stating that the insects introduced into Australia are restricted to cactaceous plants. The caterpillars of the moths, the beetles and the bugs were given the opportunity to feed on various grain crops (maize, oats, wheat, barley) and legumes in Brisbane, but did not do so. In spite of all the evidence brought forward above, the Commonwealth Prickly Pear Board, in its desire to make assurance doubly sure, determined to carry out an exhaustive series of tests

before authorising the liberation of any particular insect. A summary of these tests—some in Australia and some in U.S.A.—with the various kinds of insects, carried out since the writer relinquished control of the investigations, has been published by my successor (Alexander, 1925). From the scientific aspect none of these tests were necessary, but appeared to the Board to be advisable from the public point of view. There need be no hesitation in liberating all or any of the insects therein referred to.

A very important part of the work consisted in eliminating from the importations all parasites and predators affecting the cactus insects in their native homes. It is of interest to note that certain Australian ladybirds that feed widely on soft-bodied scale insects (mealy bugs) readily attack the cochineal insects which belong to the same group (Coccidae). This applies especially to *Cryptolaemus montrouzieri,* mentioned as a likely enemy by the Travelling Commission in 1912, and referred to from time to time since then (see First Ann. Rep. of Prickly Pear Land Commission, 1925 (pp. 21-25), in which the widespread distribution of cochineal insects against prickly pear in Queensland is also mentioned (pp. 107, 8).

As various statements have appeared in the Press and elsewhere regarding the introduction of "Chico" cochineal *(Dactylopius tomentosus)* by Mr. T. Clerk from Chico, in Northern California, it might be pointed out that the Travelling Commission referred to its presence there in 1913. Immediately prior to my taking up the appointment as Scientific Controller of the Prickly Pear Investigations (June, 1920) Mr. Clerk received by post a few small packages containing "pads" of *Opuntia* with cochineal on them. As their receipt by him was a contravention of the Commonwealth Plant Quarantine regulations he handed them to me unopened. On examination it was found that the pear was decomposed and practically all the insects were dead. The few living larvae present were transferred to fresh pear collected in the vicinity, the old material being destroyed on account of the danger of introducing parasites. These larvae were housed in my laboratory in the University, Brisbane, and tended by him and by one of my entomological assistants until my return from America (1921). It was from the progeny of these larvae that Mr. Clerk obtained the material which he privately bred up and distributed at Dulacca and Westwood in Queensland, some being sent to Mr. Froggatt, who liberated it near Scone, N.S.W.

Subsequent consignments (1921) of the same species were received from my assistants in U.S.A. and bred up in the Board's laboratories along with the progeny of the original "Chico" strain. In official accounts no mention is made of these facts, and though Mr. Clerk deserved credit for his work, it must not be overlooked that a most important factor in its success was its preliminary handling by my staff. Had any of the numerous parasitic moths, flies, and beetles which so effectively control cochineal in America, been allowed to obtain a footing in the Commonwealth (as might readily have occurred but for my action when the material was received), the very important influence now being exerted by the various kinds of cochineal must have been seriously affected.

Literature.

1925 Alexander, W. B.—Natural Enemies of Prickly Pear and their introduction into Australia. Bull. 29, Commonw. Inst. Sci. and Industry, 1925.

1912 Hunter, W. D., Pratt, F., and Mitchell, J. D.—The Principal Cactus Insects of U.S.A. Bull. 113, Bur. Ent., U.S.D.A.

1923 Johnston, T. H.—The Australian Prickly Pear Problem. Rep. Austr. Assoc. Adv. Sci., 16, pp. 347-401.

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ECOLOGICAL NOTES AND DESCRIPTION OF PREVIOUSLY UNRECORDED FEATURES OF ONITHOCHITON ASHBYI, B. and M., ACANTHOCHITON CROCODILUS, T. and A., TOGETHER WITH DEFINITIONS OF A NEW CALLOCHITON (POLYPLACOPHORA).

By Edwin Ashby, F.L.S., M.B.O.U.

[Read August 12, 1926.]

Onithochiton ashbyi.

Onithochiton ashbyi, Bednall and Matthews, Proc. Mal. Soc. Lond., vol. vi., pt. 2, p. 92, 1906.

O. ashbyi, of Torr, Trans. Roy. Soc. S. Austr., vol. xxxvi., p. 151, 1912.

O. ashbyi, of Iredale and Hull, Austr. Zool., vol. iv., pt. 4, p. 266, 1926.

Owing to the fortunate rediscovery by the writer of this rare chiton on 2nd April last, one is able to add some additional information respecting it. Neither the original description nor the more recent one by Iredale and Hull, make any reference to its habitat, other than the fact it was found in this State, no information respecting its station and no reference is made to the existence of "eyes." One is also able to add to the previous knowledge of its girdle characters. As this is the only known species of chiton inhabiting the waters of South Australia that is possessed of well-developed "eyes," information respecting this feature is the more valuable.

History.—Prior to the present rediscovery, only three examples had been found. The first, the type, was found by the writer on rocks at low water at Port Willunga, about the year 1896, and was placed in Bednall's hands for description with another novelty, taken by the writer at the same time. Bednall some time later sent the two, to I think Sowerby; both were lost in the post, the *Onithochiton* was recovered at the G.P.O., London, the other specimen was never seen again. It was not described until 1906, or ten years after its discovery. The second specimen was taken about five years after the first, at the same spot; this was crushed and lost on the journey to London in 1922. The third specimen was found by Mr. Walter Klem and identified by Dr. Torr when they were working together near Corney Point, Yorke Peninsula. In (?) 1918, it was taken on a rock in a deep hole at extreme low water. The exact spot was visited by the writer in company with Klem last January, but no *Onithochitons* were forthcoming.

On April 2 another attempt was made at the original locality at Port Willunga. The tide was an unusually low one, so that he was able to work for nearly half an hour quite 20 yards beyond the spot where his earlier discovery had been made.

Station.—It will be seen that four out of the five known specimens have been taken by the writer at Port Willunga, and each of these has been adhering to a smooth, calcareous alga, which at that spot encrusts many of the rocks; Mr. Klem informed the writer that his find was on similarly encrusted rocks. Three of the examples have been on the pink algae, and the second specimen on the green; in each case the colour of the animal has harmonised with the colour of its host. In common with other members of the genus they cling very tightly to the rock, the elastic girdle being so expanded as to completely fill the small cavities of the rock surface, with which it corresponds so closely in colour, that it is difficult

to distinguish the animal. Their station, we may conclude, is on more or less exposed rocks which at lowest spring tides are still covered with 2 feet of water at the bottom of the tide, and only occur on rocks that are encrusted with the particular alga referred to above. The discovery near Corney Point indicates that it may be searched for in both gulfs.

Eye-pits.—The description of the shell surface published by Iredale and Hull need not be repeated, as it well indicates the nodulose sculpture, but, as before stated, no reference is made to the "eyes." Torr, in the brief notice he gives of this species *(l.c.)* says, "The 'eyes' are of a pearly appearance, set in its cream coloured valves." This refers to Ashby's example No. 2, which had been bleached by formalin and is now lost.

"Eyes" are scattered without any definite order about the tegmentum of the anterior valve and a single diagonal row on each lateral area, consisting of 5 to 7

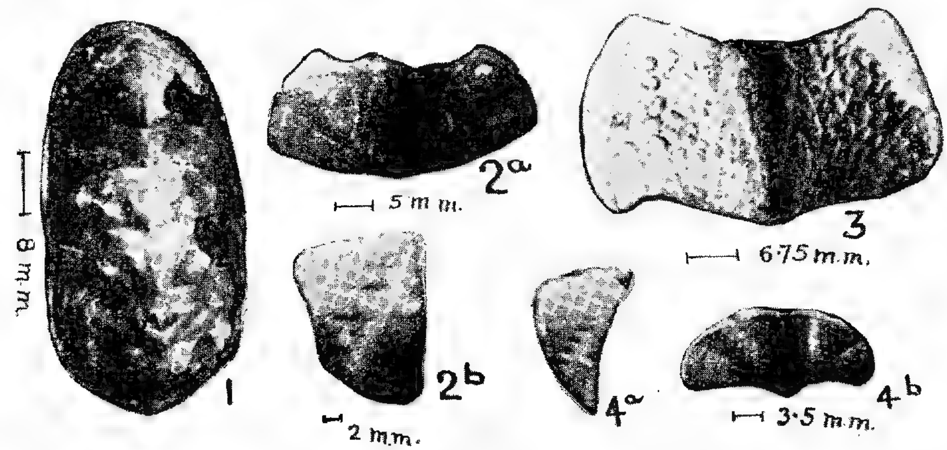


Fig. 1. *Onithochiton ashbyi*, Bednall and Matthews, Port Willunga. Topotype, whole shell. Ashby coll. Shows smooth, unsculptured surface and raised, irregularly nodulose, lateral areas; the dark blotches on valves 2, 5, and 8 are red. ×6.

Fig. 2. *Callochiton rufus*, Ashby. Dredged in Gulf St. Vincent. Holotype. Ashby coll. Median valve showing shallow pits and ridges across pleural areas. (a) full valve, ×7; (b) side view with strong lateral lighting to show pits, ×8½.

Fig. 3. *Acanthochiton crocodilus*, Torr and Ashby, Daly Head. Ashby coll. Median valve, showing coarse, triangular granules and coarsely toothed edging of dorsal area (pinnatifid). ×7.

Fig. 4. *Callochiton klemi*, Ashby, Daly Head. Holotype. Median valve showing short, broadly-ovate pits. Ashby coll. (a) side view, shell accidentally broken but showing pits, ×8½; (b) same valve complete before accident, ×7.

"eye-pits," this row commencing near the jugum and extending to the girdle. There are two or three perforations present in the lateral portion of the tail valve which may possibly be the remains of "eye-pits," but the origin of these has not been accurately determined. The "eye-pits" in the anterior valve and lateral areas of the median valves are 10 μ in diameter, whereas my measurements of this organ in the Western Australian species *O. scholvieni,* Thiele, are 15 μ, and in the type species of the Genus *Tonicia (T. elegans)*, 25 μ. The "eye-pits" in *O. ashbyi* are funnel-shaped, the apex ending in a hole penetrating the tegmentum. The sides of these funnel-shaped apertures glisten, as if they had been washed with mercury or burnished with some shiny substance. Is it possible that this shiny surface is the remains of the cornea?

Girdle.—Bednall and Matthews, in their description of the type, state: "Girdle felty, but under the lense covered with minute scales, irregular in size and shape, like grains of sand." The only reference to the girdle in Iredale and Hull's description is: "Girdle horny, in dried type shell." The former were quite correct in recognising the existence of scales, for the girdle is clothed with minute, arenaceous scales, but the existence of a distinct girdle fringe has heretofore been quite overlooked. Both examples examined possess a very distinct girdle fringe which is composed of closely packed, short, stout, glassy spicules with blunt apices; they measure 30 to 35 μ in length and 5 μ in width.

Measurements and Colour.—The specimen in spirit measures 9 mm.$\times$almost 5 mm., of which the girdle accounts for fully 2 mm. The other dry example measures 8 mm.$\times$4 mm. In colour, the dry specimen is uniformly "Pompeian Red" (Ridgway, pl. xiii.); the other has two large lateral red blotches on valves 2, 5, and 8; the rest of the shell buffish-cream.

Acanthochiton crocodilus.

Acanthochites crocodilus, Torr and Ashby, Trans. Roy. Soc. S. Austr., vol. xxii., pt. 2, p. 216, 1898.

A. crocodilus, of Torr, Trans. Roy. Soc. S. Austr., xxxvi., p. 161, 1912.

Acanthochiton crocodilus, of Iredale and Hull, Austr. Zool., vol. iv., pt. 2, p. 86, 1925.

Amongst the material collected by Mr. Walter Klem, of Corney Point, Yorke Peninsula, at Daly Head, is a single median valve of this rare species. Hitherto this shell has only been known from the two original specimens found by Torr while he and the writer were working together at Marino in this State, over thirty years ago, and a single valve collected by Klem.

Station.—No information has previously been given as to the station of this species, and therefore the following notes will be of value. Torr and the writer were working well away from the shore at an exceptionally low tide; the portion of reef upon which we were working was covered by about 2 feet of water. Torr pulled up a rock upon upperside of which, between the stems of brown algae, were two pale-coloured *Acanthochitons,* side by side. No other live example of this chiton has been seen or taken since. If memory serves me rightly there was no covering sand, as is so often the case with members of this genus, but they were well exposed on the smooth rock, between the stems of growing brown algae. Early in, I think, 1920 a specimen was loaned to the writer by Mr. Basset Hull under the name of *A. coxi,* but although very eroded was certainly not conspecific with that species—he advised Hull that it was in his opinion *A. crocodilus;* Torr confirmed this opinion later. In *l.c.,* vol. xliv., p. 286, 1920, Ashby recorded this occurrence, noting that Hull had it from the collection of Mr. Brazier, presumably from New South Wales. Iredale and Hull have recently distinguished the shell from that State under the name *Acanthochiton crocodilus debilior.*

As no good figure of a median valve of this species has been published I include a photograph of the median valve from Daly Head, which has been compared with a median valve of the type.

Callochiton klemi, n. sp.

I am indebted to Mr. Walter Klem, after whom I have much pleasure in naming it, for the gift of a single median valve of a new and distinct species of *Callochiton,* which he found amongst shell-grit at Daly Head, Yorke Peninsula.

Description of Median Valve.—Carinated, although at the jugum it is rounded, elevated, side slope steep and almost straight; dorsal area beaked,

longitudinally much arched and laterally rounded, unseparated by sculpture from the pleural area; pleural area similarly sculptured to the dorsal area except that portion immediately abutting on the lateral area, which is ornamented with a row of deep, broadly-ovate pits, numbering five, the lateral area is strongly raised and crossed by several growth ridges, which are not clearly visible except by lateral lighting. The whole surface of the shell, in all areas, is seen under 65 magnifications, binocular microscope, to be decorated with innumerable, shuttle-shaped, raised, minute granules, the granules themselves being distinctly pitted, while the interspaces between the granules are deep and narrow grooves; the granular sculpture in the lateral areas is a little coarser, here a large proportion of them are furnished with a distinct pit with a dark centre; these may be an enlarged development of the megalopores or minute "eye-dots," they are probably connected with the terminals of sensory fibres. The "eaves" do not overhang, are spongy, *i.e.*, studded with perforations, a character that is common to members of this genus; the sutural laminae are joined across the middle line, but are too worn to allow of the determination of either the depth or the breadth of the sinus, but this is probably broad and shallow, neither can the slitting be accurately determined, although the bases of three grooves is discernible in the insertion plate.

Summary of characters present that are typical of the Genus *Callochiton*:—

(a) The eaves are thickened and spongy.

(b) The sutural laminae are united across the median line.

(c) The insertion plate shows three grooves which may be the bases of three slits or due to propping.

(d) The surface of the shell, ×65, is quite characteristic of the Genus *Callochiton*.

COMPARISONS.

Is distinguished from *C. platessa*, Gould, and *C. elongatus*, Hed. and May, by the deep, short, wedge-shaped pits, at the junction of the pleural and lateral areas. From *C. rufus*, Ashby, in that the pits are short and deep and double the number. In *C. rufus*, the pits are shallow, widely apart, and each pit has on the upper side a longitudinal ridge which extends across the valve. From *C. mayi*, Torr, in that there is no longitudinal ribbing in the pleural area.

Colour.—Between "Shrimp Pink" and "Strawberry Pink" (Ridgway, pl. i.).

Measurement.—Lateral measurement, 3·5 mm.; longitudinally, barely 2 mm.

Habitat.—Daly Head, between Cape Spencer and Corney Point, Spencer's Gulf, Yorke Peninsula.

NOTE ON THE DISTRIBUTION OF MYCORRHIZA.

By Geoffrey Samuel, B.Sc.,
Lecturer on Plant Pathology, University of Adelaide.

[Read September 9, 1926.]

The writer's attention has lately been drawn to the subject of mycorrhiza in South Australia from two different angles.

In one case the investigation of an obscure oat disease prevalent on the volcanic soil around Mount Gambier and on the black clay soil near Penola, in the south-east of this State, revealed extensive invasion of the roots of affected oat plants by a fungus with the typical characters of endotrophic mycorrhiza. Shortly after this discovery a recent American paper (2) was seen which described the widespread occurrence of a mycorrhizal fungus in the roots of legumes and a few other plants in America. This led to an examination of the roots of legumes in South Australia, and all of the twenty-seven species so far examined have been found to be infected with the mycorrhizal endophyte. The examination has been extended to the roots of other crop and fodder plants, and finally to common introduced weeds and native plants, the large majority of those so far examined being found to be infected to some extent with the fungus.

Simultaneously with this, attention was called to the same subject by the behaviour of pines in "seed-spotting" tests in connection with afforestation. When *Pinus insignis* seed was planted in small roughly prepared holes over recently cleared ground, it was found that in some of the "spots" the seedlings came away well and were a good green colour, whereas in others they remained small and yellowish. Examination of the roots of each showed the healthy pines to be abundantly supplied with mycorrhiza (ectotrophic), whereas in the stunted specimens mycorrhizal roots were lacking or poorly developed. In the carefully prepared soil of nursery beds the trouble was not evident, or if some pines did show poor growth they soon recovered, presumably owing to the spread of the mycorrhizal fungus to their roots from their close neighbours. There would naturally be no recurrence of such trouble in subsequent years of planting the nursery.

In connection with this the roots of *Eucalyptus rubida*, which was the dominant tree on the area, were examined, and were found also to be possessed of an ectotrophic mycorrhiza. It would seem likely that the roots of very many, if not all, Eucalyptus species, may possess such mycorrhiza.

It is with the endotrophic type of mycorrhiza that this note mainly deals, however. The term mycorrhiza should perhaps be used with some qualification. It seems usually to imply that a majority of the roots of a plant possessing it should be actually infected. When the roots of large numbers of plants are examined, however, it is found that while some species are very extensively invaded by the fungus, in others only one or two small laterals may be found infected, and all gradations between these extremes exist in others. In the present work a plant has been listed as possessing mycorrhiza, however small in amount the infection has been found.

It remains to be investigated how far soil and other conditions determine the amount of infection. That they may do so to a considerable extent is evident from a comparsion of the roots of wheat and oat plants grown at Mount Gambier and near Adelaide respectively. In the former case the mycorrhizal fungus is extremely abundant, and the cells with arbuscles often so filled with the characteristic minute granules which are here quite green, that it is easy to see the

infected roots with the naked eye. In the latter case, however, it often requires careful search to pick out infected roots.

The determination of the presence of mycorrhiza rests in all cases upon a section of the root showing the characteristic non-septate mycelium ramifying abundantly in the inner layers of the cortex without apparently injuring the host cells, and forming, usually just without the endodermis, either "arbuscules" or "sporangioles." Vesicles were fairly abundant in some species, but were not seen in others; the characteristic lemon-shaped spores have only been found on one occasion so far. Considerable variation exists as to the relative abundance and development of arbuscules, sporangioles, and vesicles in the roots of different plants. The details of these variations are reserved for a later paper, however.

In this small preliminary survey the mycorrhizal endophyte as above described has been found in species belonging to the families Leguminosae, Gramineae, Liliaceae, Ranunculaceae, Violaceae, Geraniaceae, Euphorbiaceae, Rosaceae, Plantaginaceae, Compositae. The list of species examined is not given *in extenso*, since it is beyond doubt that many more species in these families, and also species in many other families, will subsequently be found to be infected.

The fact that all species so far examined in the families Leguminosae and Gramineae (27 in the former, 30 in the latter) are infected, especially abundantly in the Leguminosae, renders it highly desirable that more should be known as to the physiological relationships existing in this peculiar partnership. As yet no definite proofs or disproofs of the various theories advanced have been adduced. Of these, that of Janse (1), who considered the endophyte as possibly assimilating free nitrogen and transmitting it to the plant, and that of McLennan (3), who considered (in the one case with which she worked, *viz.*, the genus *Lolium*) that the endophyte might supply carbohydrate material from the soil, need further experimental investigation.

Finally, attempts to isolate the mycorrhizal endophyte have so far failed. This was also the experience of Janse (1), Peyronel (5), and F. R. Jones (2). Peyronel (4, 5) has lately described the occurrence of mycorrhiza in wheat and other crop and wild plants in Italy, and finds that there is frequently an association of two endophytes, one of which, a *Rhizoctonia*, he has been able to isolate with ease. So far this has not been determined in South Australia.

It is a pleasure to record the assistance afforded by the Imperial Bureau of Mycology in lending the papers of Janse and Peyronel.

References.

(1) Janse, J. M.—"Les endophytes radicaux de quelques plantes javanaises." Ann. du Jard. Bot. de Buitenzorg, xiv. (1896), 53-201, 11 pls.

(2) Jones, F. R.—"A Mycorrhizal Fungus in the Roots of Legumes and some other Plants." Journ. Agr. Res., xxix. (1924), 459-470, 3 figs., 2 pls.

(3) McLennan, E. I.—"The Endophytic Fungus of *Lolium*. II. The Mycorrhiza on the Roots of *L. temulentum*, with a discussion on the physiological relationships of the organism concerned." Ann. Bot., xl. (1926), 43-68, 3 pls.

(4) Peyronel, B.—"Sulla normale presenza di micorize nel grano e in altre piante coltivate e spontanee." Boll. Mens. R. Sta. Pat. Veg., iii. (1922), 43-50. Abstr. in Rev. App. Myc., ii., 172.

(5) Peyronel, B.—"Prime ricerche sulle micorize endotrofiche e sulla micoflora radicicola normale delle fanerogame." Riv. di Biol., v. (1923), 463-485, 11 figs., and vi. (1924), 17-53, 14 figs. Abstr. in Rev. App. Myc., iii., 539.

SPECIES OF THE ISOPOD FAMILY SPHAEROMIDAE, FROM THE EASTERN, SOUTHERN, AND WESTERN COASTS OF AUSTRALIA.

By W. H. Baker.

[Read September 9, 1926.]

Plates XXXVIII. to LIII.

Owing to the kindness of the authorities of the Australian Museum, Sydney, I have been enabled to examine the Sphaeromids in that institution. The paper deals with this material and with examples recently added to the South Australian Museum collection, as well as a few that have been forwarded from Western Australian Museum. Naturally, most of the specimens in the Australian Museum series are shallow water forms from the eastern coast, many of the species which are common on the southern coast not being represented.

The now well-known marked sexual dimorphism occurring in this group has induced authors to recommend that species should be established on adult males only. I have kept this in view, describing females only when they exhibit some striking characters.

Although the group has much resemblance to the Cymothoidae, none of the species seem to be addicted to parasitism; apparently Sphaeromids are, in the main, scavengers, and are thus of economic importance. Although some swim actively, most are rather sluggish; many live in sponges, etc., where the two sexes are often taken together, thus helping to confirm relationship in doubtful cases. The Australian Sphaeromids are not well known, and systematic collecting—which is much needed—has been neglected; as a result, one very often has only single specimens to deal with, which are frequently females.

It is with great diffidence that I introduce the new genus *Cymodopsis,* chiefly to relieve the very large genus *Cymodoce,* and I claim for it the same value as *Cilicaea, Cilicaeopsis,* and *Paracilicaea.* Six species are allotted here, and *Cymodoce aspera,* Haswell, which might otherwise be included, I have left out, believing that species to be nearer to *Bregmocerella.*

Subfamily SPHAEROMINAE.

Group Hemibranchiatae, Hansen.

Sphaeroma terebrans, Bate.

Pl. xxxviii., figs. 11, 12.

Sphaeroma terebrans, Bate, Ann. Mag. Nat. Hist. (3), vol. 17, p. 28, pl. 2.
S. vastator, ibid, p. 28, pl. 2, fig. 4.
S. destructor, Richardson, Bull. U.S. Nat. Mus., No. 54, p. 282, and figs.
S. terebrans, Stebbing, Spolia Zeylan. vol. 2, pt. 5, p. 16, pl. 4.
S. terebrans, Barnard, Ann. S. Afr. Mus., vol. xvii., pt. v., p. 358.
S. terebrans, Calman, P.Z.S., 1921, Crust., ii., p. 217.
S. terebrans, Chilton, N.Z. Jnl. Sci. and Tech., 1919, p. 12, note.

There are a large number of specimens in the collection, the largest about 8 mm. in length. In some the tubercles are quite small and the pubescence varies considerably. In some specimens identified by Dr. Chilton the posterior extremity of the abdomen is much more pointed, the primary tubercles of the thorax and abdomen more distinct, except the two submedian on the anterior division of the abdomen. The margin of the end of abdomen is turned upward, and below still

close to the tip is a distinct swelling. In some examples the end of abdomen appears to be turned downward. In nearly all specimens examined there is a distinct tubercle or dipping of an inner fold on the margin of the epimeron of the 1st thoracic segment. Sometimes the lines marking the coalesced segments of the anterior division of abdomen are very obscure, at others, as in Stebbing's figure, the same statement applies to the transverse ridge on 4th segment of thorax, and there are frequently similar ridges on 3rd and 5th segments as observed by Barnard.

The 3rd joint of antennule seems to vary, it is often as long or longer than the two preceding joints together. Most specimens have 4 teeth on outer ramus of uropod.

With a large number of dry specimens from Queensland, there was one differing, the posterior region of which is shown in pl. xxxviii., fig. 13. I find in some earlier notes on a large number of specimens from the eastern coast, the remark, "These seem to be all juveniles," made on account of the absence of *appendix masculina*. I am glad to find the explanation in the above paper of Dr. Calman's.

SPHAEROMA QUOYANA, Ml. Edw.

Pl. xxxviii., figs. 1-10.

Sphaeroma quoyana, Ml. Edw., Hist. Nat. Crust., t. iii., p. 206.
S. quoyana, Heller, Reise de Novara Crust., p. 137.
S. quoyana, Haswell, Cat. Austr. Crust., p. 287.
S. quoyana, Hedley, Austr. Assn. Adv. Sci., vol. 8, 1901.
S. pentodon (?), Richardson, U.S. Nat. Mus. Bull. 54, p. 286.
S. verrucauda, Dana, U.S. Expl. Exp. Crust., ii., p. 779, pl. lii., fig. 6.
S. verrucauda, Chilton, N.Z. Jnl. Sci. and Tech., 1919, p. 12.

The body has many black dendritic markings and is obscurely granulate. The head is anteriorly depressed, there is a well-marked rostrum with a transverse ridge behind it. The eyes are large.

A distinct transverse ridge is found on the 4th, 5th, 6th, and 7th segments of thorax.

The sides of the posterior division of abdomen slope inwards sufficiently to allow the uropods to be almost completely hidden.

The anterior portion of epistome is slightly excavate.

The flagellum of the antennule has 11 joints.

The antennal flagellum has 14 joints.

The left mandible has a small secondary plate, the spines are 9 in number, the incisory plate is narrow obscurely divided into 3 lobes or teeth, the joints of the palp are broad and compressed.

The 2nd maxilla has broad plates densely fringed.

In the maxillipeds a large portion of the 2nd joint and its plate is folded longitudinally; the hairs on the plate are dense and some plumose; the coupling spine is a long curved setum.

The legs are in 3 series, the 7th pair the longest.

The 2nd pleopod has the appendix slightly exceeding the length of endopod. The exopod of the 3rd is without division. The 5th has the exopod with 3 shagreenate lobes on the distal division and one on the proximal.

The uropods are rather small, lanceolate, the inner ramus reaches to the end of abdomen, the outer ramus is 4- or 5-toothed—sometimes the teeth are obsolete—it has a longitudinal keel below; both rami are fringed with fine hairs.

This species is very common on the east and south coasts of Australia and is credited with wood destruction, but sometimes found burrowing in mud probably containing decaying wood or seaweed.

Exosphaeroma intermedia, n. sp.

Pl. xxxix., figs. 1-8.

Body rather smooth, punctate, with obscure rounded areolae like fish scales and some minute setules.

Head short, with a transverse ridge on the forehead. Eyes large.

1st thoracic segment longest; the following subequal in length. The epimera of 2nd, 3rd, and 4th segments are subacute, those of 5th, 6th, and 7th rounded, the 7th not so deep.

The posterior division of abdomen is widely dome-shaped all over, the end is somewhat truncate and entire.

The two basal antennal joints are contiguous, these are short, triangulate, the base of triangle being the distal end, there they are a little bilobed by a small sulcus about the middle, 2nd joints small and short, 3rd joints narrow, flagellum short with 12 joints.

Antenna moderately robust, flagellum of 13 joints, the first 5 or 6 short, the others becoming longer.

Epistome somewhat quadrate, anteriorly with a mucronate apex or partially covered by basal antennal joints, the limbs recede.

The right mandible is slender, not salient, the incisory plate 4-lobed, then follow a number of curved branched spines. The molar is prominent with margin fringed with numerous denticles. The palp is large, its distal joint falcate.

1st maxilla with inner branch short, ending in 5 large branched spines. The outer branch has 8 or 9 strong spines, some of which have lateral branches, the shaft is setose on each side.

The 2nd maxilla has broad leaf-like lobes; their margins with many serrate spines.

The maxilliped has the basal joints narrow, the plate of the 2nd joint ends in a mass of branched spines with a row of similar ones on inner margin for some distance. The 2nd joint of palp is only separated from the 3rd by a small shallow cleft and is scarcely lobed, the 3rd and 4th are strongly lobed bearing setae, and are as in Cymodoce and other genera.

The legs are all robust, provided with furry pads on 4th, 5th, and 6th joints, the first 3 pairs carry long setae on 3rd and 4th joints, but they are not so long or numerous as in *Sphaeroma*. In the remaining legs the basos and ischium bear longish fine hair and also some strong spines in the usual positions on those limbs.

The pleopods are very sphaeroma-like, broad, the peduncles of the first 3 pairs have each 3 coupling spines on inner sides and furry hairs on outer. In the 2nd pair the appendix much outreaches the endopod to which it is attached.

The exopods of the 3rd and 4th pairs have each a division. There is a distal gap on the respiratory ramus of the 4th pair. The exopod of the 5th pair has prominent setuliferous lobes with fine hair on the outer margin.

The uropods are subequal, the inner ramus is ovate-lanceolate, the outer with 2 teeth on the external margin with slight indications of 2 more above these.

One male specimen, 8 mm. long, found on a clump of live coral, Vanderlin Island, Sir Edward Pellew Group, Gulf of Carpentaria, June, 1923, collected and presented by Dr. W. E. J. Paradice, Royal Australian Navy, to Australian Museum; it being the type.

Exosphaeroma bicolor, n. sp.

Pl. lii., figs. 1-5; also pl. li., figs. 8, 10.

Body surface nearly smooth, glabrous. The segments of thorax do not differ much in length. The epimera are marked off from the tergites by a faint groove on each side. The epimeron of 1st thoracic segment projects anteriorly beneath

the eye but the posterior angle is abrupt, the lower margin is straight, the following 3 epimera are rounded, separate, and rather sinuate; the last 3 are deeper and broader rounded, that of the 7th segment reaches down to near the level of the 6th. The anterior division of abdomen is a little longer than the 1st thoracic segment; obscurely divided by lines into 4 segments; the lateral margins of this division reach to the level of the 6th thoracic epimera. The head is short, steeply declivous in front; a faint swelling marks the place of the rostrum. The eyes are large and prominent with many ocelli. The posterior division of abdomen is moderately domed, declivous behind with a reduction in steepness near the end which is obtusely pointed; the margin here is a little insinuate in vertical direction.

The peduncular joints of the antennule are subequal in length; the 1st has a shallow distal notch; the flagellum has 10 joints. The joints of the antennal peduncle are short and stout; the flagellum carries 11 joints.

The epistome is elongate, rounded anteriorly, its lateral limbs receding. The upper lip is prominent.

The right mandible has the incisory plate rather slender, tridentate, no definite secondary plate, spine row well marked, with strong molar, and palp with compressed joints, the last narrow, falcate, it and the middle joint comb-like.

The 1st maxilla is strong, the inner branch with 4 curved plumose setae, the outer branch with 4 or 5 distal, blunt teeth and a few serrate spines; the outer margin of this branch bears some fine setules. The 2nd maxilla has large lobes bearing strong setae.

The maxilliped has the plate of the second joint rather elongate, the distal setae well developed. There is an inner fold with 3 feather setae. The palp is large, the 2nd, 3rd, and 4th joints are well lobed with rather scanty setae; these joints have each a setum posteriorly (as noticed in *Zuzara*, etc.).

The legs are robust, well spined, with moderate furry pads on 4th, 5th, and 6th joints.

The 1st pleopod has the peduncle projecting more than usual on the inner side with 5 coupling spines which are not so crowded as usual, the outer side is bent down in the proximal direction. The rami are rather small. The endopod about as long again as broad, its outer margin slightly concave. The exopod has a large outstanding spine slightly curved. The 2nd pleopod also with rather small rami; the *appendix* is thick, obtuse, and over-reaches the endopod considerably. The peduncle has a strong setum on outer angle. The 3rd pleopod has the exopod with division near the middle of lamina. The peduncle has 3 or 4 longish setae on outer angle. In the 4th pleopod the endopod has few branchial folds (6-7), the apex is rather acute, and there is a broad shallow insinuation near by, and one plumose setum. The exopod carries 3 distal similar setae and a number of setules on the outer margin. The rami of 5th pleopod are rather narrow. The exopod has a distal rasp slightly prominent and 2 lobed with similar thickenings almost continuous on inner margin for some distance as in *E. calcareus*. The endopod has few branchial folds (6-7) and is distally truncate with a small elevation on the inner angle.

Uropods have the inner ramus rather broad not reaching the end of abdomen, subacute at end. The exopod is narrower, longer, lanceolate, very acute, reaching beyond end of abdomen.

Length, 10 mm.

This species is near *Exosphaeroma calcareus*, Dana, and *E. falcatum*, Tattersall. It has the habit of rolling into a ball with the outer rami of the uropods outstanding. The female has a less projecting abdomen than the male and the rami of uropods are equal in length. The specimens (8 males and 2 females) are from shore between tide limits, Kangaroo Island, and were collected by Mr. H.

M. Hale, Zoologist of the South Australian Museum. Type, C. 1050, South Austr. Mus.

Exosphaeroma alii, n. sp.

Pl. li., figs. 6, 7, 9.

The body is smooth and glabrous. The head is rounded in front and very short. The eyes are large. The 1st segment of thorax is longest, the remaining are subequal in length except the last, which is shorter. The 1st epimeron has the lower margin nearly straight, abrupt behind, the remaining ones are nearly uniform in size, except 2nd and 7th, the 7th is a little smaller than and not reaching down to quite the level of the 6th; they are not distinctly marked off from their respective tergites. The anterior division of abdomen is very short, the coalesced segments well marked laterally. The posterior division is not strongly domed, is smooth and shovel-shaped at end, and thin-walled.

The antennule is rather large, 1st joint broad and not much produced at inner distal angle, 2nd joint almost half as long as 1st, 3rd a little longer than this, 1st joint of flagellum longer than the rest, flagellum of 8 longish joints. The antenna has a few setae on 5th joint of peduncle, the flagellum is rather long, of 13 joints.

The epistome is rather long, apically retiring and acute; the limbs are retiring; the upper lip is large.

The right mandible has a rather slender incisory process almost entire at apex, there is a minute secondary process and a spine cluster which springs from a common base; the molar is large.

The inner ramus of 1st maxilla with 4 recurved setae, the outer ramus is rather narrow and the distal teeth much worn in specimen.

The 2nd maxilla is robust with spines on the outer and middle lobes more robust than on the inner lobe, which reaches a little beyond the other.

The maxilliped has narrow basal joints, the plate of the 2nd being also narrow; there are 2 setae on the hinder end of 3rd joint of palp and one on the 4th. The lobes of these joints are moderately long and setose.

The legs are rather slender, 1st pair with rather long fine setae on usual joints; the rest of the legs are sparely spined and setose.

The peduncle of 1st pleopod has 5 coupling spines on the inner angle, the outer side has numerous setules, the exopod has the usual outstanding spine on the outer proximal angle, the outer margin of endopod is straight or slightly convex. The 2nd pleopod has a large endopod; the *appendix* is moderately robust tapering towards the end, and reaches nearly to the end of the fringe of the endopod. The peduncle has a long setum on the outer angle as well as the usual setules. The 3rd pleopod has large rami; there are a few longish setae on the outer angle of the peduncle. The dividing line on the exopod is nearer the middle than the end, but not so much so as in the previous species. The endopod of the 4th pleopod has a very shallow, wide emargination and 3 plumose setae on the end with 2 on the end of the exopod. The rami of 5th pleopods are rather narrow, the exopod is subacute distally with 2 outstanding rasp-like lobes, the other lobes are not well marked but are similar to those of preceding species. The endopod is distally truncate with small prominence on the inner angle. Branchial folds are few on both 4th and 5th pleopods.

The uropods have laminate rami, the inner ramus has the inner margin nearly straight, the outer very convex, not quite reaching the end of abdomen, distally subacute. The outer ramus is shorter, narrower, distally rounded, and on distal margin slightly serrate.

Length, 7 mm.

The body is whitish with much dark dendritic marking. Several specimens were collected at Victor Harbour in shallow water by Miss Ali.

Type, C. 1055, South Austr. Mus.

Exosphaeroma alata, n. sp.

Pl. xxxix., figs. 9-11; pl. xl., figs. 1-3.

The body, especially the head, is rough with rather scanty tubercles which arrange themselves more definitely on the posterior margins of thoracic segments.

The head has a transverse, low ridge just behind the antennular region; behind this there are two indistinct submedian tubercles. The eyes are large.

The 1st segment of thorax is longest, the 2nd, 3rd, and 4th subequal in length, the last 3 shorter. The epimera, except the 1st and last, are subequal, the last not so deep, the penultimate one with an oblique ridge on the outer side.

The anterior division of abdomen is short, its lateral margins are slightly turned up. The posterior division is at first domed, but soon shelves away to a long posterior triangular projection with very acute apex; the posterior margin of the cavity of the abdomen is broken by a wide notch or channel opening, this is roofed over by the projecting end.

The basal antennular joints are short with rather corroded surfaces, they touch each other medianly; there is a small notch on the posterior border which holds a small lateral portion of the epistome. The 2nd joint of peduncle is short, the 3rd long, the flagellum of 9 longish joints. Antennal peduncle is robust, flagellum of 17 short joints. The epistome is short with well projecting lateral angles.

The mandibles are normal; the left with incisory plate 3 or 4 divided, secondary plate trifid, very small spine row and strong molar; palp of moderate size.

The 1st maxilla has a small tuft of setae on the middle of the shaft besides the terminal setae.

The lobes of the palp of the maxilliped are short and close together, the terminal joint is also short, at the posterior angles of the 2nd, 3rd, and 4th joints there is a long setum as in *Zuzara venosa*.

The legs are slender, very sparely spined, the last pair in the male are very long and appear to have a prehensile function; the propodus is long and curved.

The 1st pleopod has a peduncle with 3 coupling spines on the inner angle, the outer side slopes away obliquely and is destitute of fine hair. The exopod has a small outer proximal spine. The endopod is slightly longer than broad. The appendix of the 2nd pleopod reaches as far as the fringe of the endopod. The exopods of the 3rd, 4th, and 5th have oblique divisions.

The uropods are very large, wing-like, both rami are somewhat wedge-shaped and subequal, the outer have the external margins thickened and upturned, both rami are minutely serrate at the distal margins and reach beyond the apex of abdomen.

Length of male, 11 mm.

The female is of typical *Exosphaeroma* form, mouth parts are unmodified, marsupial plates overlap slightly, the abdomen is not produced, the uropods are of ordinary size, the body is much smoother.

This species is close to *E. amplicauda*, Stimpson, it is also near *Isocladus*, and if that genus is of subgeneric value, as Hansen suggests, then this also should bear a subgeneric designation.

The specimens are from Mullumbimby, New South Wales, in fresh water in the river, L. Kesteven, Riddlemore Bridge, Parramatta River, also Miller's Point, Pt. Jackson. Types in Australian Museum, Sydney.

Neosphaeroma, n. gen.

Characters mainly as in *Exosphaeroma,* but pleopod 3 with some branchial folds on the endopod.

A small number of plumose setae on both exopod and endopod of pleopod 4.

Endopods of pleopods 1 and 2 sometimes becoming very elongate, and that of No. 1 being modified in the male into an appendage of probably sexual use *(N. laticauda).*

Exopods of pleopods 3, 4, and 5 with divisions.

Type of genus, *Neosphaeroma laticauda,* Whitelegge.

Neosphaeroma laticauda, Whitelegge.

Pl. xli., figs. 1-5.

Cassidina laticauda, Whitelegge, "Thetis" Scientific Results N.S. Wales Isopoda, pt. i., p. 238.

Hansen (Quart. Journal Microscopic Science, Oct., 1905) at page 130 says: "It is impossible for me to refer—*Cassidina laticauda,* Whitelegge—this species not only to any genus, but to any section or group of the Sphaerominae." A specimen occurs in the collection of the South Australian Museum, a female from Gulf St. Vincent, which is referable to Whitelegge's species, a fact which I have been able to confirm by the kind loan of cotypes male and female from the Australian Museum.

The following additions to Whitelegge's description—"Thetis" Scientific Results, page 238—are here given:—

The body of the southern specimen is about twice the size of the cotypes.

The marsupial laminae overlap and the mouth parts are unmodified.

The 1st and 2nd pleopods are normal, but in the 3rd the exopod has a division and the endopod carries 8 branchial folds; both rami carry many marginal plumose setae.

In the 4th pleopod the exopod is 2-jointed, the endopod branchial, both rami with a few plumose marginal setae.

The 5th pleopod also has a division on the exopod with 2 setuliferous lobes on the proximal portion at its inner distal angle and 3 on the terminal division.

In the adult male (cotype of Whitelegge's) the appendages on the 7th sternum are well developed.

The 1st pleopod has the endopod narrow-elongate about 2½ times as long as broad with its inner margin modified into a peculiar sheath-like apparatus, thus from near the middle of the lamina there arise 4 long setae unlike the marginal ones in having short pinnae; these lie in the cavity of the sheath extending to its distal end.

In the 2nd pleopod the endopod is also narrow-elongate with the appendix long and folded on itself with a recess or ledge on the lamina.

The 3rd pleopod has the branchial folds on the endopod.

Except for these differences the sexes are similar.

Neosphaeroma australe, Whitelegge.

Pl. xli., figs. 6-11.

Sphaeroma australis, "Thetis" Scientific Results N.S. Wales Isopoda, pt. ii., p. 250.

The following may be added to Whitelegge's description:—

Posterior division of abdomen is broad and dome-shaped, gradually declivous to the end, the margin of which is broad, entire, and minutely serrate; from a posterior view, this has a broad insinuation in vertical direction.

The epistome is elongate, the apex rather broadly rounded, the upper lip is large.

The appendages on 7th sternum of thorax are stout, blunt, but becoming attenuated in older specimens.

The 1st pleopod has a narrow endopod not quite twice as long as broad with a strong ridge on the inner margin, the exopod is about as long as the endopod with a small proximal outstanding spine. Peduncle with 3 coupling spines on inner side and furry hairs on the outer.

The endopod of the 3rd pleopod has 3 or 4 distinct branchial folds; the exopod has a very oblique division ending inwardly with a small emargination.

Exopod of 4th pleopod carries 16 long plumose setae on the distal margin; the endopod carries 6 similar setae.

The uropods are robust; the inner ramus truncate at the end with a slight insinuation of the margin, the outer ramus is a little shorter with distal and inner margins serrate.

The female resembles the male with an end of abdomen slightly broadly rounded. The mouth parts are unmodified with the brood in the body. In another specimen there were marsupial plates meeting medianly.

Some specimens were presented by Mr. M. Ward, Sydney, to the South Australian Museum. Others in the collection of the Australian Museum are from Nelson's Bay, Port Stehpens, New South Wales.

Neosphaeroma (?) **pentaspina**, n. sp.

Pl. li., figs. 1-5.

The body is rather broad and rather flat, glabrous, integument obscurely areolate like sand grains. Head narrow and short, first 4 segments of thorax not differing much in length, 3 remaining ones becoming shorter; all the epimera reaching downwards to about the same level, as also do the side plates of the anterior division of abdomen. Anterior division of abdomen short, the coalesced segments almost becoming free at their lateral extremities. The posterior division also is rather short, evenly arched, or domed; the posterior margin is rounded obtuse.

The antennule is short, its 1st joint scarcely produced at the posterior distal angle, 2nd joint about half the length of the 1st, 3rd joint a little longer than the 2nd, flagellum of 14 very short joints. In the antenna the peduncular joints are short, the 5th bears a small longitudinal row of setules, flagellum of 15 short joints.

Epistome much shorter than in many species of *Exosphaeroma,* its apical portion retiring towards the rostral region, its lateral limbs retiring and becoming attenuate.

The left mandible has the incisory plate rather short, robust, 4-toothed, the secondary plate is tridentate, the spine row is represented by a brush of setae united at the base. The molar and palp are strong.

The inner branch of 1st maxilla has 4 feather-form curved setae, the outer branch with 6 or 7 curved teeth, the outer ones pectinate. The three plates of the second maxilla are well marked, setose, and reach the same level. The maxilliped has a rather broad distal plate to the second joint, it is distally well spined, and has a row of feather setae on the inner fold. The palp is large, the lobes of joints well supplied with setae, there are no conspicuous setae on the distal ends of posterior margins of 3rd and 4th joints.

1st leg short, robust, basos with tuft of setules behind near proximal end, ischium with long setae, some of which are feather-form, merus with posterior process bearing long setae, also setose distally, carpus and propodus also provided with long fine setae, dactylus short, 2-clawed. 7th leg long, sparely spined on setose. The pleopods are broad and large, the 1st has a rather narrow endopod with slight fold on inner margin, exopod broad with 5 conspicuous outstanding

spines near the outer proximal angle, peduncle with 4 slender coupling spines. 2nd pleopod with rather thick *appendix* reaching beyond the end of endopod. In the 3rd pleopod both exopod and endopod are broad, the exopod has the distal division occupying about one-third of the whole lamina. The 4th pleopod has well-developed plumose setae on both exopod and endopod. The exopod of 5th pleopod broadly rounded distally with one outstanding shagreenate apical lobe, another not outstanding lower down on the distal division, while just below is a smaller lobe on the proximal division.

The uropods are lamellar, the inner ramus reaching to end of abdomen, the endopod is shorter, distally rounded.

The specimens (2 males) were received dry, consequently the branchial folds of the pleopods were destroyed. My reason for placing the species in *Neosphaeroma* (?) is on account of the fringed state of the 4th pleopod rami.

Length, 10 mm.; breadth, 7 mm.

Locality, off coast of New South Wales. Presented by Mr. M. Ward, of Sydney.

Type in South Austr. Mus., Reg. No. C. 1054.

Isocladus howensis, n. sp.

Pl. 1., figs. 7, 8.

The body is short, glabrous, obscurely granular on the abdomen. Head short. 1st segment of thorax a little longer than those which follow, except the last, which has a long process reaching to the extremity of the abdomen; there is a small tubercle on each side of this. The eyes are of moderate size. The epimera are abruptly turned in the vertical direction, the last being a little deeper than those preceding. The anterior division of the abdomen is hidden by the 7th segment of thorax, the posterior division is moderately domed and tapers to an obtuse point, while below there is a shallow exit or channel to the cavity of the abdomen.

The epistome is long, rounded anteriorly, and rather tumid, the upper lip is large and distally squared or truncate. The 1st antennular joint is short, the 2nd a little longer than usual, the 3rd subequal to it in length, the flagellum has 10 joints. The antenna is robust with a flagellum of 10 joints. The mandibles have incisory plates entire, the left has a secondary plate bifid and as large as the primary, the molar process is large. The legs are robust, sparely spined, but with furry pads on the usual joints.

The 2nd pleopod has an *appendix* reaching beyond the lamina of the endopod; this is not much longer than broad, and is very convex on its outer margin. The exopod is about the same length, is very narrow at base, with the distal fringe of setae long. The 3rd pleopod has a broad endopod exceeding the exopod slightly in length, the exopod is also broad, the division being nearer the middle than the distal end. The exopod of the 4th pleopod has a few distal setae and some setules on the outer margin; the endopod has a distal shallow insinuation and an apical setum. The exopod of the 5th pleopod has 2 distal outstanding lobes, the others obscure.

The uropods are moderate in size, rather thick, reaching further than the end of abdomen; the rami are subequal, the outer rather sigmoid in shape.

Length of male, 5 mm.

The female is without dorsal process, has a more domed and less produced posterior division of abdomen, with 2 small submedian tubercles. The uropods are much smaller than in the male.

The two specimens are from Lord Howe Island, found under stones, collected by G. P. Whitley. The type is in the Australian Museum, Sydney.

This species is very near to *I. armatus,* Ml. Edw. (see Tattersall, Brit. Ant. Exp., p. 217, pl. vi., figs. 9-17).

Isocladus (?) laevis, Haswell.

Pl. l., figs. 9-12.

Sphaeroma laevis, Proc. Linn. Soc. N.S. Wales, vol. 5, pl. 16, p. 473.

This is probably the female of a species of *Zuzara* or *Isocladus.*

The posterior end of abdomen is somewhat produced; there is an insinuation in the vertical direction below, but no notch or channel of any definiteness.

The mandibles are normal (though the female examined seemed post ovigerous), incisory plates entire, molar large.

The 2nd joint of the antennular peduncle is rather large, about half as long as the 1st, the 3rd is equal to the 2nd in length. The flagellum has 9 joints. The peduncular joints of the antennae are laterally compressed with 2 stiff bristles at the distal end of the 5th. The flagellum has 9 or 10 joints, which are long. The epistome is elongate.

The maxilliped has the lobes of 2nd, 3rd, and 4th joints of palp rather short, and a long setum is situated at the posterior angle of the 2nd and 3rd joints, as seen in *Z. venosa,* Stebbing.

The legs are strongly spined.

The pleopods have short rami as a whole. In the 1st the endopod is broader than long, the exopod with rather long outstanding spine; there are 3 or 4 coupling spines on the inner angle of peduncle. In the 2nd pleopod the endopod is rather longer than broad and very convex on the outer margin. The 3rd pleopod has a similar endopod, distally obtuse; the division on the exopod is quite near the middle. The exopod of the 4th pleopod has the division near the end, and a few plumose setae. Exopod of 5th pleopod also with a division.

The rami of uropods are laminate, narrow, obtuse distally, subequal, not reaching quite to end of abdomen.

Two examples from Bondi beach, New South Wales.

Length, 6 mm., of larger specimen.

Cymodoce gaimardii, Ml. Edw.

Pl. xlii., fig. 2.

Sphaeroma gaimardii, Ml. Edw., Hist. Nat. Crust., t. iii., p. 209.

There are several representatives of this fine species in the collection. As it does not seem to have been figured, I have illustrated an example which is probably a young male.

The first 3 pairs of legs are somewhat more robust than those which follow. The epistome is tumid anteriorly; the two basal antennular joints almost touch at its apex, but further forward are separated by the small pointed rostrum.

The female (non-ovigerous) is like the male, but the posterior notch is not so deeply cut either in transverse or vertical direction, and the median process is distally rounded instead of square cut as in the male.

Length of male, 25 mm.; breadth, 14 mm.

This seems to be a southern species, it has been collected at Port Phillip (F. E. Grant) and by Professor Cleland at Encounter Bay, South Australia. It has been also reported from Tasmania and Gulf St. Vincent, South Australia. There is a small variety of this species.

Cymodoce aspera, Haswell.

Pl. xlii., fig. 1; pl. xl., figs. 9-11.

Sphaeroma aspera, Proc. Linn. Soc. N.S. Wales, vol. v., pl. 16, p. 472.

S. aspera, Richardson, Proc. U.S. Nat. Mus., 1909, vol. 37, p. 94.

The body is thick-set and broad. The head is short, steeply declivous in front, with a dorsal slight prominence and a few small tubercles. The eyes are

moderately large. The segments of thorax are also obscurely tuberculate on posterior margins; these segments become much shorter behind the 1st. The epimera have a downward direction, the more anterior ones more acute. The anterior division of abdomen has two submedian tubercles or prominences behind. The posterior division has two bosses, which are clear cut on the sides; there are two small tubercles below each, then it tapers to an obtusely pointed end with a slight incision on each side, below there is a deep channel in the vertical direction.

The epistome is prominent at its middle third, recedes anteriorly, the upper lip is large.

The 1st antennular joint is broad with a small sulcus near the distal end; the flagellum has 10-12 joints, as also has the flagellum of the antenna.

The mandibles have the incisory plates entire and strongly chitinised. On the left mandible the secondary plate is well developed, the molar process is strong.

The maxillipeds have a rather narrow basal portion, the palp has long lobes.

The legs are slender, of usual pattern, and sparely spined.

The endopod of the 1st pleopod is at base a little shorter than its length. The exopod has a projecting spine at its outer proximal angle. The endopod of the 2nd pleopod is slightly insinuate on its outer margin; this feature is more pronounced on the endopod of the 3rd pleopod. Two small plumose setae are at the distal end of exopod of the 4th pleopod, and its much thickened endopod has distally a semicircular notch. The exopod of the 5th pleopod has two projecting setuliferous lobes on the proximal division and three on the distal, and is ciliate on its outer margin.

The uropod is slightly fringed with hair, the rami do not reach nearly to the end of abdomen, the inner ramus is rather broad and distally truncate, the outer is much smaller and is umbonate at the end.

There is in the collection a specimen of 6 mm. and another of 11 mm. by 7 mm.; the larger is not nearly so tuberculate.

The male is unknown.

The specimens are from Shell Harbour, New South Wales, collected by G. McAndrew, July, 1923.

CYMODOCE ACULEATA, Haswell.

Pl. xl., figs. 7, 8.

Cymodoce aculeata, Haswell, Cat. Austr. Crust., p. 291.

The body of the male is minutely granular with a thick pubescence towards the posterior end. There is a well-defined ridge across the forehead. The abdomen is highly sculptured, on the anterior division a 1st segment is distinct, as also are the lines indicating the other coalesced segments. There is a transverse row of 6 rather obscure tubercles in the median region, and the hinder margin has two submedian projections. The posterior division of the abdomen has 6 transversely arranged tubercles, and at the end the median process is elevated above the sides of the deep notch; the 3 distal ends here are obtuse and reach the same level.

The 1st joint of the antennular peduncle is short and broad, its hinder distal process not reaching the end of the 2nd joint, which also is short; the flagellum has 15 joints. The antenna is longer, its flagellum has 17 joints.

The epistome is anteriorly rounded and tumid.

The incisory plate of the right mandible is strong and is obscurely bifid or trifid, a spine row is present, and the molar is rather weak.

The legs are well spined and provided with the furry pads on meri, carpi and propodi in each.

The endopod of the 1st pleopod is rather longer than broad, its inner margin has a partial fold forming an open channel, the exopod has a strong outstanding spine, the peduncle has 3 coupling spines on the inner margin and fine hairs on the outer.

On the 2nd pleopod the appendix is straight, slender, and reaches beyond the fringe of the endopod; its base is scarcely bulbous and does not project below over the peduncle.

The 3rd pleopod is large with the exopod divided rather near the end.

The uropod has subequal rami, the inner is obliquely truncated, with a small tubercle near the distal end. The outer ramus is distally acute, its outer margin straight and strongly ridged; there are small teeth on the inner margin. There is a small tubercle on the peduncle.

Length of male, 19 mm.

The female has a much less sculptured abdomen. On the posterior division there are two obscure submedian bosses, and the posterior notch is very much less cut, but with the median lobe projecting a little beyond the sides of notch.

In a tube containing 64 specimens there were no ovigerous females, but young of both sexes were plentiful.

From Jervis Bay, New South Wales.

Cymodoce bidentata, Haswell.

Pl. xl., figs. 4-6.

Cymodoce bidentata, Proc. Linn. Soc. N.S. Wales, vol. vi., p. 189.

C. bidentata, Cat. Austr. Crust., p. 291.

The sides of the body in the regions of the thorax and abdomen are nearly straight, granulate, and with a rather scanty coarse pubescence, both of which are more pronounced posteriorly.

The head is long, rounded anteriorly where it shows from above parts of the antennules and rostrum when extended. The eyes are moderate, and there is a small oblong indentation on the vertex. The 1st segment of thorax is not much longer than those which follow. The epimera project downwards, the last 3 being wider than the others.

The anterior division of the abdomen has on its posterior border 2 submedian projections, flanked by 2 lateral tubercles, with 2 or 3 on each side more lateral and more obscure, from which spring tufts of longer setae. The posterior division which descends rather abruptly bears 2 tubercles, each nearly under the projections of the anterior portion; below these are two submedian spiniform tubercles turned upwards at their tips, and below these a median spiniform tubercle also upturned. The posterior notch is wide, its median process is lingulate, slightly bifid at the tip, and projects a little beyond the sides of the notch.

The epistome is rather broad, a little tumid anteriorly, with acute apex.

The 1st antennular joint is of moderate length, the 2nd small and partially embraced by the 1st, the 3rd joint is long, the 1st joint of the flagellum is half as long as it; the remaining joints are short and number 18, as also does the flagellum of the antenna.

The mandibles are normal, incisory plates entire, as also is the secondary plate on the left; spine row is well developed.

Maxilliped is rather small, the lobes of palp of moderate length.

The legs are rather sparely spined, the spines being stronger on 1st pair.

The 1st pleopod has endopod slightly longer than broad, a little insinuate on its inner margin towards the end, with the more proximal part of margin folded inwards. Exopod with proximal outstanding spine turned up at tip, 4 coupling spines are on the inner angle of the peduncle, and the usual furry mass of hair

on the outer side. 2nd pleopod with the *appendix* exceeding the endopod by about half. Exopod of 3rd pleopod with division rather near the end.

The uropods are indurated and thickened, very setose and granular to spinuliform. The inner ramus is large and somewhat sigmoid, terminating in two acute teeth, one of which is subterminal and below. The outer ramus is small and much shorter, also with a terminal and subterminal tooth. There is a small tubercle on the peduncle above.

One male specimen from 100 faths. off Tasmania was collected by Mr. C. Hedley, and is in the Australian Museum, Sydney.

CYMODOCE UNGUICULATA, Barnard.

Cymodoce unguiculata, Barnard, Ann. S. Afr. Mus., vol. x., pt. xi., p. 394, pl. xxxiv.B.

There are in the collection three immature specimens which appear to belong to this species. They were taken by Mr. H. M. Hale in 5 faths. at Beachport, South Australia, accompanied by a species so close to *Exosphaeroma varicolor*, Barnard, that I hesitate to separate it. It is interesting to note that these two species are from the same locality in South Africa.

CILICAEA CRASSA, Haswell.

Pl. xliii., figs. 1, 2.

Cilicaea crassa, Proc. Linn. Soc., N.S. Wales, vi., p. 186.

The posterior division of abdomen, including the space between the two bosses, is so steep that it projects beyond the end, and between the two bosses the process of the anterior portion is seen on an inferior view. The end of the abdomen itself is trilobed, the notch widening inwardly; the median process of this is lingulate and directed downwards.

The exopod of uropod is best shown by the figures in two positions.

The legs are robust, the basal (basos) joints of the more posterior ones carry small strong teeth on their posterior margins.

The epistome is short and small.

CILICAEA SPINULOSA, Haswell.

Pl. xlii., fig. 4.

Cilicaea spinulosa, Haswell, Proc. Linn. Soc. N.S. Wales, vi., 1882, p. 184, pl. iii., fig. 3; *id.*, Cat. Austr. Crust., 1882, p. 297.

C. spinulosa, Whitelegge, "Thetis" Scientific Results Isopoda, pt. ii., p. 265.

This species has a very deep posterior notch visible from above with two denticles in it; a median process in this notch is very small.

The epistome is short, small, slightly tumid medianly, with a large labrum.

The body is covered with a coarse pubescence which becomes thicker behind.

The eyes are large and ovate.

The legs are very spinose.

CILICAEOPSIS STYLIFERA, Whitelegge.

Pl. xlii., fig. 7.

Cilicaea stylifera, Whitelegge, "Thetis" Scientific Results Isopoda, pt. ii., p. 267.

The end of abdomen has a deep exit channel (of a type very common, as will be seen), a median lobe is perhaps very obscurely indicated.

The epistome is short and rather broad with a small obtusely pointed knob on its anterior part which projects obliquely downwards.

The eyes are small, rounded, and prominent.

CILICAEOPSIS ORNATA, Whitelegge.

Pl. xlii., figs. 3-5.

Cilicaea ornata, "Thetis" Scientific Results Isopoda, pt. ii., p. 269.

The end of abdomen has a deep and narrow channel which at its exit is roofed over by the acutely pointed end.

The epistome is similar to that of *C. stylifera,* except that the pointed knob is more evident and projects forward. The spiniform tubercles are well disposed in transverse rows.

The eyes are small and rounded.

Cilicaeopsis obesa, n. sp.

Pl. xliv., figs. 8-11.

The body is ovate, glabrous except on uropods, and very convex in both directions. The segments of thorax are about the same length, except the 1st. Viewed from above when the animal is stretched out the head shows a slight rostral prominence; this is excavated and wide, separating the two basal joints of the antennules. There is a transverse ridge on the forehead. The eyes are moderately large.

The anterior division of abdomen is long and shows the sutures of suppressed segments plainly; the posterior margin is broadly arched. The posterior division is dome-shaped, has a very faint prominence medianly, and a steep descent to near the posterior end, which again shelves off a little, the margin having a small $\wedge$-shaped notch visible from above and also a broad and similar shape in the vertical direction. The epimera are marked off by distinct sutures; that of the last segment is shorter than the rest.

The epistome is short and broad.

The basal antennular joint is scarcely excavate distally to receive the 2nd joint, the 3rd joint is rather long. Flagellum of 6-8 joints. Antenna with flagellum of 10 joints.

Mandible—right—with incisory plate rather slender; there are 6 curved spines, a molar strong and prominent, and small palp.

The maxilliped has the palpal joints with long lobes nearly as in *Cymodoce tuberculosa,* Stebbing.

The legs are strong and well spined in the 1st pair, the dactyli are stronger than in those following.

The pleopods are broad. The 1st has the endopod broader than long. The exopod, which is narrow, has the inner distal angle almost a right angle, and it has an external projecting spine at the base. Peduncle with 3 obscure coupling spines and the usual dense hairs on the outer side. The 3rd pleopod has a broad endopod a little insinuate on the inner margin and distally truncate. The exopod also is broad with division not so near the end as in *Paracilicaea stebbingi* and others. The exopod of the 4th is also broad, that of the 5th much narrower; this is mostly covered with setules at the distal end with one lobe projecting more, the lobe on the proximal division also projects.

The uropod is much reduced with short inner ramus as in most species of *Cilicaea.* The exopod is expanded, thickened, short, and covered with small teeth which become spiniform on the margin with small hairs between them.

This description is taken from a non-ovigerous female; in an ovigerous female the mouth parts are modified and the marsupial laminae overlap.

Length, about 9 mm.

Several females from Shell Beach, New South Wales; the type and co-types are in the Australian Museum, Sydney.

Cilicaeopsis corpulentis, n. sp.

Pl. xliv., figs. 1-7.

Body very convex transversely and longitudinally, covered with a fine woolly tomentum which in some specimens is scanty.

The head is broad, gradually declivous in front, with a sulcation across the forehead, it is about as long as the 1st thoracic segment; the antennular and rostral region projects a little. The segments of thorax do not differ much in length after the 1st. The epimera are vertical in direction, obtuse, and marked off by distinct sutural lines; those of the 7th segment are not so deep.

The anterior division of the abdomen is produced behind as a process which is adherent and curved to the general surface and does not reach its end; below this in the median region is a depression which divides the posterior division into 2 lobes which, though well marked, are not tumid. The posterior margin is broad, obtuse, with a broad shallow insinuation shown below and visible from behind. The cavity of the abdomen has thick walls.

The epistome is rather small, anteriorly truncate, the upper lip large.

The 1st antennular joint is broad and short, the 2nd joint not much embraced by the 1st, the 3rd joint is long. Flagellum of 18 joints. The antennal flagellum has 15 joints.

The mandibles show a concentration of strength in the incisory processes; these are highly chitinised and distally overlap. There is a strong spine row on the right mandible, but the molar is small and the palp very small. The secondary plate on left mandible is trifid.

1st maxilla of moderate size, distal spines of outer ramus highly chitinised, inner ramus is comparatively feeble.

The maxilliped is rather slender.

The legs are robust and strongly spined with strong dactyli.

The pleopods are broad in general aspect. The endopod of the 1st is triangular, about as long as broad, with a fold on the inner margin and a small distal emargination like as shown by Stebbing in *C. latreillei* (Ceylon Fisheries). Exopod with strong outstanding spine, inner angle of peduncle with 3 coupling spines.

The *appendix* on the 2nd pleopod is long and whip-like, its base is strong and downward depressed, its distal portion channelled with marginal setules.

The 3rd pleopod has broad rami as in *Paracilicaea.*

The 4th pleopod bears two distal plumose setae on the exopod, the endopod is thick and much folded.

The uropods are much reduced, the outer ramus is subcylindrical, the inner is also thick and reaches to end of abdomen.

This species is near *C. dakini,* Tattersall; it also much resembles the two species of *Paracilicaea* of this account, especially *P. pubescens,* Ml. Edw. In epistome, antennules, antennae, legs, pleopods, etc., it is difficult to distinguish from those of *Cilicaea latreillei,* Leach.

Length, 14 mm.; breadth, 9 mm.

There are three specimens from Port Stephens, New South Wales.

The type is in the Australian Museum, Sydney.

Cilicaeopsis halei, n. sp.

Pl. xlii., figs. 6, 8, 9.

Body almost glabrous; there are a few longish hairs on the uropods.

The head is rather long, a little umbonate above. The eyes are large. The 1st segment of thorax is a little longer than those which follow, the last is shorter and narrower, faintly sinuous on posterior margin. The epimera have each a small prominence and the lower lateral margin of 1st segment is turned up.

The anterior division of abdomen has the median region raised and is produced behind to 2 small projections with another median, and above, which is flanked by 2 obscure ones near its sides; this division also carries 2 obscure lateral tubercles. The posterior division has two submedian bosses; medianly it becomes abruptly declivous, then gradually so to the pointed end. There is an insinuation in the vertical direction which medianly is a channel, but there is no notch.

The 1st joint of the antennule has its distal angles not much produced. The flagellum has 10 joints. The antenna is robust with longish peduncular joints and a flagellum of 11 joints.

The epistome is anteriorly broad with a small tubercle on each side.

The right mandible has incisory plate 2 or 3 dentate. The left is entire with a long bifid secondary plate. The molars are very large.

The palp of maxilliped has long lobed joints nearly as in *Cymodoce tuberculosa,* Stebbing.

The legs are sparsely spined, not differing much from each other except that the 1st pair is a little weaker.

The 1st pleopod is more thickened than those that follow, the external spine of the exopod is small and non-projecting. There are 3 coupling spines in the peduncle, and externally it is destitute of the group of soft hairs. The exopod of the 3rd pleopod has the division well towards the middle of lamina, the endopod is broad and its outer margin slightly insinuate. The next 2 pleopods are hemibranchiate, the 4th having broad rami. On the exopod of the 5th there are 4 setuliferous lobes, one of which is outstanding; the external margin of this lamina has fine hairs.

The uropod is as in *Cilicaea,* a short inner ramus with the external ramus much longer, slender and a little curved.

Length, 6 mm.

The type, which is placed in the Australian Museum, Sydney, is one female specimen from Port Jackson.

This species seems to be near *C. dakini,* Tattersall, and *C. ornata,* Whitelegge.

Paracilicaea (?) pubescens, Ml. Edw.

Pl. xliii., figs. 8-11; pl. xlviii., fig. 1.

Sphaeroma pubescens, Ml. Edw., Hist. Nat. Crust., t. iii., p. 209, 1840.

Cymodocea pubescens, Haswell, Proc. Linn. Soc. N.S. Wales, vol. v., p. 473 pl. xvi., fig. 1, 1881.

C. latreillei, Miers, Zool. H.M.S. "Alert," pp. 308-310, 1884.

C. pubescens, Hansen, Quat. Jnl. Micro. Sci., vol. xlix., pt. i., p. 122, 1905.

C. pubescens, Stebbing, Trans. Linn. Soc., vol. xiv., pt. i., p. 104, 1910.

C. pubescens, Stebbing, Ceylon Pearl Fisheries, Sup Repts. No. xxiii., p. 38, 1902.

The adult male of this species does not seem heretofore to be known. The following characters are taken from a specimen which, I believe, to have that standing:—

The pubescence of the body is very distinctive, short, thick, the individual hairs are like scales on stalks; the surface of the body is also granulate. In the abdomen the mesial lobe of the notch falls short of the sides.

The mandibles are normal, rather short, with incisory processes entire, secondary plate and spine row on the left well developed, the molar strong.

On the 1st leg on the 3rd, 4th, 5th, and 6th joints the spines are numerous; on the others the spines, although small, are also numerous on 4th, 5th, and 6th joints. The dactyli are short.

The pleopods resemble closely those of *C. latreillei,* including the very slight insinuation on the distal end of endopod of 1st pair.

The uropods have the cilicaeform characters.

The female of this species is of a more ovate shape, the anterior division of the abdomen is shorter and not so much produced backwards, the bosses on the posterior division are not so large. The mouth parts are much altered and the brood is internal. These females are also scarcely to be distinguished from those of *C. latreillei,* Leach; the pubescence, of course, is very different.

In the collection of the South Australian Museum are some specimens which I refer to this species somewhat doubtfully, a juvenile (see pl. xliii., fig. 11; pl. xlviii., fig. 1).

The New South Wales specimens are from Port Jackson and Port Stephens, and are common on the eastern coast.

Since writing the above I have observed two male specimens which, although preserving closely the structure of the female, yet, by the development of the *appendix masculina*—which has the long whip-like character—it would indicate their at least nearness to the adult state. Alternatively the inference might be drawn that there are 2 forms of the male. Further observation it will be seen is necessary. I must say that I have not seen the above *Cilicaea* form of male among specimens from the southern coast.

Paracilicaea stebbingi, n. sp.

Pl. xliii., figs. 3-7.

The body is smooth, glabrous. Head rounded anteriorly, rather short. Eyes of moderate size.

The 1st segment of thorax is the longest, the following 3 subequal in length, the last 2 are shorter, the last is obscurely tuberculate on posterior margin with 2 lateral tubercles more pronounced. Anterior division of abdomen short, with 6 distinct tubercles on the posterior margin, with 2 above laterally placed, and between the 2 submedian there are 2 very small ones away from the posterior margin and 2 lateral tubercles on each side. The suppressed segments are distinctly marked. The posterior division is marked by 8 longitudinal ridges; there are two short submedian, two long outward from these, these end posteriorly in 2 large bosses which project beyond the end of abdomen, another pair of short ridges, then a pair of strong longer ones whose posterior ends project a little over the peduncles of the uropods. The bosses are separated by a median sulcation which descends abruptly to the posterior notch, which is deep, widening inwardly with a median lobe which only slightly projects but which nearly fills the widened basal part. The sides of the notch and the median process are slightly raised.

The epistome is of moderate size, its apical portion forms a continuous surface with the head and basal antennular joints. The upper lip is large.

The basal joint of the antennule has its lower distal angle produced to a point but falling short of the end of 2nd joint. The flagellum has 19 joints. The antenna is moderately robust, its flagellum has 19 joints.

Mandibles with incisory processes entire, and strong molars; the right with spine row, the left with bifid secondary process besides.

The legs are of the usual pattern, the 7th bears long spines in the usual positions.

The appendages of the 7th thoracic sternum are long and slender.

The endopod of the 1st pleopod about as broad as long with a strong fold on inner margin; exopod with strong proximal outstanding spine. There are 5 coupling spines on the inner side of the peduncle and dense hairs on the outer side. The 2nd pleopod has the *appendix* slender exceeding the endopod in length, its basal portion moderately bulbous. In the 3rd pleopod the rami are very broad, the exopod division is near the end. Exopod of 5th pleopod with 5 outstanding setuliferous lobes.

The exopod of uropod is large, curved, and subcylindrical. The endopod is short, not wholly visible from above.

The female differs from the male as the figure shows. The mouth parts are modified and the marsupial plates overlap.

Length of male, 11 mm.

The specimens—two—were collected by Mr. A. R. McCulloch, from Cairns Reef, Cooktown, Queensland.

Type is in the Australian Museum, Sydney.

Cymodopsis, n. gen.

Epistome variable, sometimes elongate, with a small but distinct forward projecting free portion.

End of abdomen pointed obtusely, with a more or less deep exit channel to cavity of abdomen cut in vertical direction, the end of abdomen in a lateral view often projecting slightly above and beyond the immediate exit; or it may be regarded thus, the end of abdomen is a pointed median process which has completely obliterated a notch.

The endopod of 1st pleopod is usually rather narrow-elongate.

Uropods variable, scarcely foliate, often not reaching as far as end of abdomen. Exopod reduced, much altered or rudimentary, the endopod remaining normal.

Type of genus, *Cymodopsis latifrons,* Whitelegge.

Cymodopsis latifrons, Whitelegge.

Pl xlv., figs. 1-5.

Sphaeroma latifrons, Whitelegge, "Thetis" Scientific Results Isopoda, pt. ii., p. 252.

The following characters may be added to those of Whitelegge:—

The epimeral portion of the 1st thoracic segment is thickened with a swelling on the lower margin. All the epimera are vertical in direction and, except the 1st, are marked off by suture lines.

The posterior division of the abdomen is gradually declivous to an obtuse point where the deep channel exit is in the vertical direction.

The epistome is of unusual shape, it has a free obtuse upper portion which projects obliquely downward.

The pleopods as a whole are narrow. In the 1st the endopod is twice as long as broad, ciliate, and slightly folded on its inner margin. The exopod has a very long outstanding spine on the proximal external angle. The peduncle has 4 coupling spines on the inner angle and the outer side has a bent appearance noticed in other species and is furry. The plumose setae of both rami are very long.

In the 2nd pleopod the endopod is also narrow with a slight ledge near the inner margin, the *appendix* is very attenuate at the end. In the 3rd pleopod the endopod is more obtuse at the distal end, the plumose setae on the exopod reach thickly to the base of the lamina on the outer side, as also do those of the 1st and 2nd pairs. The distal division of the exopod of the 5th pleopod has 3 outstanding lobes.

The inner ramus of uropod is rather broad, distally truncate with a faint emargination, the exopod is awl-shaped in outline but is a little flattened with a slight ridge on the underside and reaches well beyond the inner ramus.

The female has much more slender legs than the male. The outer ramus of uropod is small, ovate, and much shorter than the inner.

In the single female specimen there is no sign of brood, the marsupial plates are not formed, and mouth parts are normal.

Cymodopsis plumosa, Whitelegge.

Pl. xlv., figs. 6-9.

Sphaeroma plumosa, Whitelegge, "Thetis" Scientific Results Isopoda, pt. ii., p. 254.

Body slightly hairy in tufts (the hairs plumose), convex.

Head with a rostral prominence seen from above and another behind on the forehead. Eyes large, rounded, protruding. 1st segment of thorax a little longer than each of those that follow except the last. The epimera of 2nd, 3rd, 4th, and 6th segments rather acute; all are well separated from each other. The last segment of thorax is much shorter. Anterior division of abdomen short, rather tumid medianly near posterior border. The posterior division is dome-shaped and has 2 obscure tubercles medianly, behind this the surface shelves away to an obtusely pointed end slightly insinuate at the sides, below there is a short channel which is rather deep. A transverse ridge near the exit of cavity of abdomen carries a row of curious setules with knobbed heads.

The epistome is very long with large upper lip and a rounded apex not visible in a view from above.

1st joint of antennule broad and short, minutely granular with flagellum of 7 joints. Antennal flagellum of 10 joints.

The mandibles are weak, incisory process 3 or 4 dentate; a secondary plate is on the left mandible; a molar is present.

The maxilliped has its palp with moderately long lobes.

The legs are strong and uniform with strong dactyli, sparsely spined and furred.

The pleopods have the endopod of the 1st not quite twice as long as broad; the exopod is broad with its proximal spine weak and not projecting. There are 3 coupling spines on the inner angle of the peduncle and the outer side is cut away and non-setose. In the 2nd pleopods the *appendix* is indicated but not separate from the lamina of the endopod (this condition also occurs in a cotype specimen). There are only indistinct folds on the endopod of the 4th, but the lamina itself is large and evidently respiratory, there is a division on the exopod and both rami are tipped with a few plumose setae, the distal emargination of the endopod is shallow. The 5th pleopod has endopod with oblique folds faintly discernable, the setuliferous lobes on the exopod are not well defined.

The rami of the uropods are subequal in length, both distally truncate, and not reaching end of abdomen.

In a female (damaged cotype) the young were in the body, the mouth parts were normal. In another male specimen examined, the respiratory folds were more developed, but the appendix was quite as much undetached as in the above, although the appendages of the 7th sternum were more developed. The sexes are similar. Length, 7 mm.

From trawl net "Goonambee," 70-80 faths., off Port Jackson, C. W. Mulvey; also one cotype, 39-46 faths., off Green Cape, New South Wales, A. A. Livingstone and H. A. Fletcher. A specimen is in the Adelaide Museum from Mr. M. Ward, Sydney.

Cymodopsis gorgoniae, n. sp.

Pl. xlv., figs. 10-13

The body is granulate on exposed parts, the smooth areas on segments indicating that the animal is capable of bending in opposition to the usual direction, especially about the middle of the body. There are few scattered setae on the abdomen and epimera. It is highly calcareous.

The head abruptly descends in front, the basal joints of the antennules and rostrum being quite underneath; on the forehead are two low tubercles with a smaller one behind. The eyes are medium in size and projecting. The 1st

thoracic segment is nearly as long as the 3 which follow together, the others are short, especially the last. The epimera are marked off by distinct suture lines and are a little turned in below, those of the 2nd, 3rd, and 4th are subacute, those of the 5th, 6th, and 7th obtuse and rounded, that of the 7th not reaching the level of the preceding. The anterior division of abdomen is short, medianly a little projecting behind, and there inclined to divide into 2 tubercles. The posterior division has 2 submedian bosses somewhat pointed behind with a rather deep sulcation between them. The end is obtusely pointed, below it shows an exit of channel which is rather narrow, the end being a ledge sloping upward.

The basal antennular joint is broad and short, the 2nd joint is rather quadrate in shape, the 3rd is longish; the flagellum has 6 joints. The antennal flagellum has 10 joints.

The epistome is rather tumid in the middle with small labrum.

The mandibles and other mouth part are metamorphosed.

The legs are long and moderately spined.

The 1st pleopod has the rami marked with minute areolae, the exopod has a small outstanding spine. The endopod is a little longer than broad; the peduncle has 4 long coupling spines on the inner angle and the usual mass of hair on the outer side. In the 2nd and 3rd pleopods the endopods are broad and distally truncate, in the 3rd the division is near the end of exopod and the endopod is very convex on its outer margin. In the 4th the exopod is tipped with 2 or 3 setae, the endopod has a distal gap which is rather wide and one setum. The exopod of the 5th is narrow with 3 or 4 outstanding lobes.

The uropod is small, indurated, and does not reach the end of abdomen, the inner ramus is distally rounded, as also is the outer.

The single specimen is an ovigerous female with marsupial plates and young in the body.

In a smaller non-ovigerous female in the same tube, the ledge-like termination of abdomen is not developed, so that there is a simple notch visible from behind forming the exit to channel; also in this specimen the end of inner ramus of uropod is truncate and the outer is more ovate and a little serrate on margin. The tip of epistome is also more acute.

Length of type specimen, 6 mm., placed in Australian Museum, Sydney.

From Long Reef, New South Wales, associated with *Gorgonias*.

There may be noted two deviations in the same sex; more may be expected in the undiscovered male. The species is here placed in the genus *Cymodopsis* provisionally.

Cymodopsis crassa, n. sp.

Pl. xlvi., figs. 1-11.

The body of the female is almost glabrous, dorso ventrally thick, especially in the region of the 1st thoracic segment, strongly declivous anteriorly from the 2nd thoracic segment and gradually declivous posteriorly. Epimeral portions of segments deep, nearly vertical in direction, the 2nd to 7th marked by distinct sutural lines.

Head short, with a very slight transverse depression between the eyes.

The segments of thorax become shorter in posterior direction, the 7th being very short.

The anterior portion of abdomen is short without any projections, the posterior bears 2 conical bosses, the depression between them being shallow; behind these the surface is abruptly declivous, then gradually so to the very obtusely pointed end which has a wide, rounded, shallow insinuation in the vertical direction.

The epistome is rounded and rather tumid anteriorly, bearing a large upper lip.

The 1st antennular joint is short and broad, its distal end moderately embracing the 2nd joint, the 3rd joint is as long again as the 2nd. The flagellum has about 27 short setose joints, the 1st of which is half as long as the preceding peduncular joint.

The peduncle of the antenna is longer than that of the antennule, its 5th joint reaching its whole length beyond the peduncle of the antennule, its flagellum has about 20 joints sparingly setose.

The maxillipeds have rather long palpal joints sparingly setose.

The legs are of the usual type with strong dactyli and sparingly spined.

The inner ramus of uropod is slightly falcate, not reaching the end of abdomen; it has a slight groove or slit at the end. The outer ramus is rudimentary.

The following details refer to the male:—

The right mandible has incisory plate obliquely entire, there follow 7 stout curved pectinate spines, the molar is short and strong.

The 1st pleopod is large, with exopod longer than broad with a strong projecting spine at the exserted proximal angle. The endopod is twice as long as broad. The peduncle is narrow and carries 4 coupling spines on the inner angle; the outer side has a dropped-down appearance and does not reach the angle of the exopod; it is sparingly hairy.

The endopod of the 2nd pleopod has a long whip-like appendix.

The exopods of 3rd, 4th, and 5th pleopods have each a division, that of the 4th acuminates to an acute point and that of the 5th is rather narrow with 1 setuliferous lobe on the inner distal angle of the proximal portion and 2 on the terminal.

The uropod is as in the female.

In the female, though of large size, there are no marsupial plates and the mouth parts are normal. The male specimen was much damaged, and except for some mounted parts has, unfortunately, been lost. The larger female measures 12 by 8 mm.; it was pink in colour with very small dark spots when fresh.

Dredged in about 6 faths., Gulf St. Vincent, by H. M. Hale.

Type in South Australian Museum, Reg. No., C. 573.

Cymodopsis wardii, n. sp.

Pl. xlvi., fig. 12; pl. xlvii., figs. 1, 2.

The body is rather broad. The head has a transverse ridge anteriorly which forms on each side a subacute angle. The eyes are large and prominent. The segments of thorax do not differ much in length except the last, which is very short. The epimera are well defined from the tergites, obliquely projecting; those of the 2nd, 3rd, and 4th are subacute, the others more obtuse, the last is quite short. The anterior division of the abdomen is short and unarmed. The posterior division is dome-shaped with 2 submedian bosses not very strongly marked, and from these the surface descends rather abruptly to the pointed end which below is widely insinuate, in the vertical direction medianly there is a very short exit channel but no notch in the usual sense. The cavity of the abdomen is deep and the uropods are capable of a vertical position, thus acting as props.

The epistome is very long, especially in its anterior part; broadly rounded anteriorly and projects a little beyond the front of the head.

The antennular peduncle is robust, its 1st joint broad and granular, the 1st joint of flagellum is half as long as 3rd joint of peduncle; it is composed of 4 long joints. The antenna also is unusually robust, its 1st joint of flagellum is subequal in length to the last peduncular joint; there are 11 joints.

The right mandible has incisory process entire, is rather slender, the spine row and molar are well developed. The molar has some longish denticles on the margin. The palp is large.

The maxilliped has the distal plate of 2nd joint large and the palp has long lobes to joints.

The legs are sparsely spined, a conspicuous plumose setum is found at the end of propodus of some.

The pleopods have unusually long peduncles. 1st pleopod has endopod much longer than broad, the exopod with small, scarcely projecting proximal spine turned up at tip. Peduncle with 2 or 3 coupling spines on inner angle and sparely hairy on the outer side. In the 3rd pleopod the exopod is without division —that I could detect—and the endopod is curiously folded obliquely—this occurs on both. The exopod of the 5th pleopod has 3 lobes on the distal division and 2 on the proximal; the distal division is triangular in shape, and on the outer side there is a group of bristles at the end of the division line.

The uropod has a strong inner ramus which is obliquely truncate at the end with the inner angle produced to a point; it does not reach the end of abdomen. The external ramus is very small.

Length, 4 mm. One non-ovigerous female in bad preservation, collected by C. W. Mulvey, trawler "Goonambee," 78-80 faths., off Port Jackson.

Type placed in Australian Museum, Sydney.

Cymodopsis albaniensis, n. sp.

Pl. xlvii., figs. 3-7.

The body is short, deep, with a very coarse and scanty tomentum. The head is short, the eyes of moderate size. The 1st segment of thorax is longest, the rest becoming shorter posteriorly. The anterior division of abdomen is short, the suppressed segments faintly marked above but distinctly cut on the lateral margin. The posterior division is marked by two domes not very prominent and not deeply divided from each other medianly, the surface then has an abrupt descent to the scarcely produced and obtusely pointed end, which is very obscurely trilobed, the lateral lobes only visible from a side view; the exit channel from the cavity of abdomen is moderately deep.

Basal antennular joint is broad, 2nd joint small, 3rd rather short, flagellum of 10 joints. Antenna slender, flagellum of 10 joints.

The epistome is arcuate and a little tumid anteriorly; this portion stands out from the head and projects downward, so that there is a small excavation between it and the rostrum.

Mandibles with incisory plates entire, the secondary plate on the left mandible is slightly bifid, the spines in the spine row are strong, and there is a large molar.

The maxilliped is rather large, the distal plate of 2nd joint large with some strong dark-tipped spines on its inner fold below the apical spines, which are crowded; the palp is large with lobes rather long, the terminal one slender.

The legs are robust. The 1st with very strong spines on merus, carpus, and propodus, the 5th with some thorn-like spines on the basos.

The first 2 pleopods are very similar to those of *C. latreillei* and *P. pubescens*. There is a distal insinuation on the endopod of the 1st, which is longer than broad and slightly insinuate on the outer margin; the exopod is narrow with a strong outstanding proximal spine; there are 4 coupling spines on the peduncle. The 2nd pleopod has a long whip-like *appendix*.

The uropod has a large peduncular portion, the endopod is broad at the base, where it is fused to this, tapering to a truncate end, which does not reach

as far as the end of the abdomen; the exopod is much narrower and shorter with a strong tooth on the outer side, the terminal half is minutely serrate on the margin.

This species is like *C. aspera*, Haswell; it also is like the young female of *C. latreillei*, also female of *P. pubescens*.

Length, 7 mm., one specimen from Albany Island, not in good preservation.

The type is in the Australian Museum, Sydney.

Cassidinella incisa, Whitelegge.

Pl. xlviii, figs. 2, 3.

Cassidinella incisa, Whitelegge, "Thetis" Scientific Results Isopoda, pt. i., p. 242.

The median region of the anterior division of abdomen is tumid; the posterior division has 2 rather obscure bosses above; the acute end is raised above the lateral processes, forming a partial channel or exit to the abdomen below. The acute epimera are thickened, as also are the uropods.

The 3rd joint of the antennular peduncle is very short, and the 1st joint of the flagellum is subequal to it; the flagellum is short with 8 joints. The flagellum of the antenna has the same number of long joints; both are scarcely setose.

The pleopods, which are those of a female, are in rather bad condition; both exopod and endopod of the 4th are tipped with a few plumose setae; the exopod of this has a division, as also has the exopod of the 3rd pleopod. The pleopods themselves are narrow, but otherwise do not differ from those of Hemibranchiatae.

Length, about 5 mm.

There are in the collection three rather damaged specimens with one slide of pleopods.

Collected by C. W. Mulvey, trawler "Goonambee," 75-80 faths., off Port Jackson.

Group EUBRANCHIATAE, Hansen.

Dynamenella rubida, n. sp.

Pl. xlviii., figs. 4-7.

The body is slightly granular or punctate, glabrous.

Head short and rather narrow. The eyes are large.

The 1st segment of thorax is longer than those which follow, these being subequal in length.

The epimera are vertical in direction, not showing distinct sutural lines.

Anterior division of abdomen is quite short, the markings of coalesced segments obscure.

The posterior division of abdomen is moderately dome-shaped, shelving away gradually to an obtusely pointed end, and which bears a small $\wedge$-shaped notch which is partially tubular, the exit of a channel which widens inwardly.

The epistome is elongate, apically obtuse, carrying a very broad and long upper lip.

The 2nd joint of the antennule is half as long as the 1st, the 3rd nearly as long as the 2nd, tumid; the flagellum has 8 short joints. The antenna is stout, the peduncle with short joints, flagellum of 12 short moniliform joints.

In the maxilliped the plate of 2nd joint is subequal to the joint itself.

The legs are short and stout, not differing much in length, with furry pads in the usual positions, few spines and strong dactyli. In the 7th the merus and carpus are subequal in length, the propodus equal to merus and carpus together; the ischium is also subequal to the propodus. The fringing plumose setae on the pleopods are unusually long.

The exopod of the 1st pleopod is much larger than the endopod; it, as well as a portion of the endopod, is indurated and areolate, there is a ledge on the endopod on which the contiguous part of the exopod rests. This structure is seen in other related species and has been noted by Barnard and others. There is no outstanding spine on the exopod. The endopod of the 2nd pleopod also has a ledge on which rests the *appendix;* this is thick, and reaches to the end of the lamina, in this case the endopod is much larger than the exopod, being about as long as broad. There are 4 coupling spines on the peduncle. The exopod of the 3rd pleopod is unjointed. Any divisions that may be on the exopods of the 4th and 5th pleopods are obscured by branchial folds.

The uropod has subequal rami; they are ovate-laminar with entire margins.

One male specimen from Maroubra, New South Wales. The colour is pinkish with scattered dark markings. Length, 5 mm.

The type is in the Australian Museum, Sydney.

CERCEIS TRIDENTATA, Ml. Edw., var. **intermedia,** n. var.

Pl. l., figs. 1, 2.

Cerceis tridentata, Ml. Edw., Hist. Nat. Crust., t. iii., p. 221.

C. tridentata, Baker, Trans. Roy. Soc. S. Austr., vol. xxxii, 1908, p 153

The posterior division of abdomen has 2 very obscure bosses, each capped with an obscure tubercle. The posterior notch is deep, and there is a median process whose free part is small, but there are indications on the integument of a much larger uncut base. The channel below is long and deep, the abdominal walls being turned in below, as also are the epimera of the thoracic segments.

The epistome acuminates to an acute point. The upper lip has a setose fringe which, with the setae on the plates of the maxillipeds, covers the mandibles.

The inner distal angle of the 1st antennular joint is produced to the end of the 2nd joint, which itself is also distally pointed; the outer angle is scarcely produced, the flagellum carries 8 or 9 joints. The antenna is slender, its flagellum has 12 joints.

There are five females in the collection and one male, which apparently is not quite mature, as the *appendix masculina* is still undetached from its lamina. All are much smaller than the southern specimens of *C. tridentata;* they are devoid of pubescence on the abdomen, which is sometimes the case with that species from southern waters.

From floating sargasso weed, south-west of Vanderlin Island, Sir E. Pellew Group, Gulf of Carpentaria, June, 1923, Dr. N. G. J. Paradice, R.A.N., 4 females, 1 male; also 1 female, Bowen Jetty, Queensland, E. H. Rainford.

Australian Museum, Sydney.

Cerceis ovata, n. sp.

Pl. xlix., figs. 1-5.

The body is ovate, strongly convex, almost glabrous.

The head is short, anteriorly there is a transverse ridge and a faint indication of 2 lobes, posteriorly there is a distinct median boss near the border in the female.

The eyes are moderate in size.

The first segment of thorax is a little longer than those which follow and these do not vary much in length; they are marked by some obscure, short, longitudinal ridges towards the sides.

The epimeral plates of thorax project obliquely, the 2nd, 3rd, and 4th are narrower than the following two, the last a little shorter.

The anterior portion of the pleon is short and squared laterally, the coalesced segments well marked at the sides. The posterior portion is dome-shaped, then tapers to an obscure end, on which is a rounded simple notch, shallow, and not conspicuous from above; this is the exit of a rather deep channel.

In the male the anterior portion of the pleon has an obscure median tubercle, and the dome on the posterior portion is very obscurely divided into 3 lobes.

The 1st antennular joint is broad, its outer distal angle is acute and a little turned outwards, the inner embraces the 2nd joint for the whole of the joint's length. The 3rd peduncular joint is rather longer than the 2nd. The flagellum carries about 13 joints.

The peduncle of the antenna is longer than that of the antennule by the length of the 5th joint, its flagellum also has 13 joints.

The epistome is elongate and tapers anteriorly to an obtuse point which stands out a little from the obscure rostrum.

The right mandible is moderately robust, and has a prominent incisory process cut into 4 dark teeth; the secondary plate is small, also dark, and is followed by 4 curved spines. The molar is long, robust, and edged with small teeth. The left mandible has the secondary process stronger.

The hypopharynx is more prominent than usual.

The outer branch of the 1st maxilla has 7 strong simple spines.

The maxilliped has the plate of the 2nd joint rather broad with few terminal spines; the palp is large with joints lobed and well spined.

The legs are robust and moderately spined and of usual type.

The 1st pleopod has the exopod more than twice as broad as long, distally truncate, bearing 7 strong teeth on its external border; there is only a small projecting spine on the proximal external angle. The endopod is about twice as broad as long. The inner angle of peduncle has 3 coupling spines.

In the 2nd pleopods the rami are similarly proportioned with *appendix masculina* attached to the endopod at about the middle of its inner margin, and it reaches beyond the plumose setae. The exopod has 12 teeth on the outer margin.

The endopod of the 3rd pleopod reaches nearly as long as the exopod, which has a division line nearer the middle of the lamina than the end.

In the 4th pleopod the exopod has a distal emargination, but a division could not be seen.

The exopod of the 5th pleopod has 3 distal lobes with the division line rather near the end; there is another small lobe and a few setules on the inner margin.

The inner ramus of the uropod is broad, reaches to the end of the pleon, and is terminally truncate with a rounded inner angle. The outer ramus is shorter and distally very obtusely rounded and toothed.

The female is much larger than the male with the posterior channel not quite so deep. The mouth parts are modified. The brood seems to be deep in the body.

There are three specimens in the collection from 6 faths., Gulf St. Vincent—an ovigerous female and a non-ovigerous, and a male.

Length of male, 7 mm.; female, 12 mm. long, 7 mm. broad.

Types, with two slides, are in the South Australian Museum.

Exocerceis, n. gen.

Head narrowing much anteriorly.

Posterior division of abdomen with a notch and raised median process in the notch in the male.

1st joint of antennule with distal angles not prolonged.

Maxillipeds with long lobes on palpal joints.

Exopod of 3rd pleopod not jointed.

Otherwise as in *Cerceis*.

Type of genus, *Exocerceis nasuta*, Whitelegge.

Exocerceis nasuta, Whitelegge.

Pl. xlviii., figs. 10-12.

Cerceis nasuta, "Thetis" Scientific Results Isopoda, pt. ii., p. 276.

The posterior division of abdomen has a median tubercle rather obscure with a small furrow below it. The submedian tubercles are keel-like.

The epistome is convex and the very setose upper lip covers the mandibles.

The *appendix masculina* on the 2nd pleopod is as in *Cerceis*, but the exopod in both sexes carries several strong subterminal comb-like spines.

The exopods of pleopods 4 and 5 are unjointed.

The rami of the uropods are broadly lamellar, serrate on margins, nearly equal, the outer one is slightly spoon-excavate.

Platycerceis hyalina, n. subgen. and sp.

Pl. lii., figs. 6-11.

The body is much compressed dorso-ventrally, smooth, almost glabrous, in the living state hyaline. The head is somewhat triangular, produced laterally to acute angles in front of the eyes; these are large with many ocelli. The segments of thorax are all laterally produced to acute outstanding processes, which become more curved backwards towards the posterior region. The 7th segment is shorter and laterally not so much outstanding. Faint lines mark off the epimera. The abdomen is little convex; the anterior division is marked in the usual way by the coalesced segments, and laterally is acute and projecting; the posterior division also acute at the sides terminates in two spiniform projections.

The epistome is rather large, the anterior portion a little swollen, the apex is acute.

The antennule has the 1st joint moderately expanded, distally it is produced at the inner angle, but not so far as the end of 2nd joint, 2nd joint less than half the length of the 1st, the 3rd joint is narrow. The 10-jointed flagellum has the 1st joint nearly equal in length to the 3rd peduncular joint. The antenna has the last joint of peduncle longest, the flagellum of 12 joints.

The mandibles have slender incisory plates divided into 4 teeth, the molars and palps are large.

The 1st maxilla has the inner branch with 4 curved feather setae and a small cluster of setules on its inner side; the outer branch, which is robust, has also some setules on its inner margin.

The lobes of the maxilliped palp are rather short and are sparsely setose.

The legs, except the 1st pair, are slender; there are no furry pads and spines are not numerous.

The 1st pleopod has a rather broad peduncle with 3 coupling spines, which are broad and different from those found in such genera as *Cymodoce*, etc. The exopod is much broader than long and has no outstanding proximal spine; besides the plumose setae there are 6 strong teeth on the distal margin, as in *Cerceis*, etc. The endopod is small, about twice as broad as long. The 2nd pleopod is larger than the 1st; there are 17 strong teeth on the exopod, the endopod is larger than the exopod. There is a curious hump near the inner angle of the peduncle. The 3rd pleopod has a narrow divided exopod with several distal teeth. The 4th and 5th pleopods are narrow; all rami of these are branchial, the exopod of the 5th has two outstanding rasp-like lobes.

The uropods have subequal rami, long, narrow-lanceolate, spreading, slightly curved outwards much exceeding the end of abdomen, strengthened by ridges above and below, the outer rami slightly serrate.

Length, 7 mm.; breadth, 4 mm. One female, Gulf St. Vincent, 4 faths., taken by H. M. Hale.

The type is in the South Australian Museum.

Since the above was written a male specimen has been taken. The following points have been noticed:—The epistome is apically much more attenuate. The antennule has a flagellum of 18 joints and is much more robust than in the female. The legs have strong spines on the propodal joints, except in the last pair, which is more slender. The appendages on the 7th sternum are short and thick. The exopod of the 1st pleopod has only 3 teeth. In the 2nd pleopod the exopod has 9 teeth. The *appendix masculina* is very long, reaching nearly to the end of the abdomen, and capable of forming, with its fellow of the opposite side, a cylindrical tube whose wall becomes very thin distally. The colour of this elegant species has been observed in the fresh state:—As a ground translucent, or nearly so, with brownish spots and small blue elongate areas, as follows. 1 median on the head, 4 submedian on 1st thoracic segment, 2 lateral on the 3rd, 2 submedian on the 4th, 2 lateral on the 5th, 2 lateral on the 6th, 2 on each side of the anterior division of abdomen, 2 submedian and 2 lateral on the posterior division of abdomen. There is also a median concentration of brown and yellow, more conspicuous on the posterior division of abdomen, which besides has a mottled appearance.

Haswellia anomala, Haswell.

Pl. xlviii., figs. 8, 9.

Sphaeroma anomala, Haswell, Trans. Linn. Soc. N.S. Wales, p. 473, pl. xvi., fig. 4; also Cat. Austr. Crust., p. 288.

This is the female or young of some species of *Haswellia.* The produced 7th segment of thorax is very pronounced, its apex extending to the posterior margin of the first division of abdomen.

The pleopods are as in *H. carnea* and *H. emarginata;* the general aspect is like the female of *H. emarginata,* except for the produced 7th segment of thorax.

Haswellia carnea, Haswell.

Pl. xlix., figs. 8-11.

Calyptura carnea, Trans. Linn. Soc. N.S. Wales, p. 476, pl. xvii., fig. 4; also Cat. Austr. Crust., p. 302.

The apex of process from 7th segment of thorax is slightly depressed, and below there is a broad shelf behind the cavity of the abdomen; the abdomen itself is very short and steep behind, its upper surface is very obscurely trilobed.

The antennular joint has a furrow for about half its length, the inner margin has a recess into which the side of the anterior portion of epistome rests. The epistome itself is unusually sculptured.

The tooth on inner margin of endopod of uropod is strong and rests in a small recess on the abdomen close to the side of the posterior notch. The uropods end in dense ciliae.

The legs are stout and very sparely spined.

The pleopods are of *Cerceis* form, the 1st has endopod broader than long, exopod with small outstanding spine curved backwards, and scale-like markings on the surface; on its margin are 6 strong teeth, and the distal end is truncate; outer distal angle rather acute, inner rounded. On the inner side of the broad peduncle are 3 coupling spines and the outer side is furry.

The margin of exopod of 2nd pair carries 14 or 15 teeth, the union of the short *appendix* to the endopod is nearer the distal end.

The exopod of the 3rd pleopod has a division and 5 or 6 teeth on margin.

The exopod of 4th pleopod has a blunt tooth or lobe on its outer margin near the base.

The exopod of the 5th pleopod has two long lobes on the distal part, a very obscure division quite near the end, and a small lobe on the proximal part on the inner side.

The species seems to be fairly plentiful on the New South Wales coast.

Haswellia juxtacarnea, n. sp.

Pl. xlix., figs. 6, 7.

There is a dried specimen in the collection from Lord Howe Island very much like *H. carnea*.

The process from 7th segment of thorax is minutely rugose and there are depressed areas on the same; this process completely covers the uropods as well as the abdomen. In an inferior view the exopods of uropods are seen, the endopods being largely concealed. This curious structure of end of abdomen is very different from that of *H. carnea*, as the figure shows. There is a similar sculpturing of the epistome and the antennular joints as in that species.

Length, 10 mm. Type in Australian Museum, Sydney.

Haswellia intermedia, n. sp.

Pl. liii., figs. 1-5.

The body is rough and becomes distinctly granulate behind, while the abdomen is coarsely granulate.

The head is long with a small rounded projection in front visible from above. There is a strong ridge on each side, being the outer margins of the channels, which probably have a respiratory function when the animal is rolled up; these reach nearly to the eyes, which are rather large.

Of the segments of thorax the 1st and 6th are subequal in length, the 7th is produced to a long process reaching beyond the end of abdomen, and its base almost completely covers the anterior division of the abdomen. The epimera are downward and backward directed, each with a slight excavation at the extremity. The posterior division of abdomen has a median tubercle ill-defined and narrows considerably to the end, where there is a deep notch widening inwardly with a median process which fills it, leaving only lateral slits scarcely visible from below; the process itself is distally truncate with 1 or 2 denticles reaching to the opening of the notch.

The epistome is rather long.

The distal angles of the 1st antennular joint only partially embrace the 2nd joint, which is short, the 3rd a little longer than it; the flagellum has about 15 short joints. The flagellum of the antenna has 12 joints.

The right mandible has a slender incisory process which is obscurely dentate, a small secondary process, row of spines, and molar fringed with denticles. The 1st maxilla with inner branch shorter than the outer, terminating in 4 feather-curved setae with a few setules on the inner margin. The outer branch terminates in several stout spines, none of which appear to be branched. The 2nd maxilla is well developed with its 3 lobes reaching to the same level. The maxilliped has narrow basal joints, the plate of the 2nd has 1 or 2 large-bodied setae along with those of usual size; the lobes of palp are rather sparely setose.

The legs are robust, are sparely spined, and do not show any notable characters except that the dactyles are short.

The pleopods are of the usual *Cerceis* type. The 1st pair are rather small, the peduncle short and square cut on outer and inner margins with 3 coupling spines, both rami are transverse in position, and thus are much broader than long, they are about the same size; the exopod with 6 distal teeth. In the 2nd pleopod the peduncle has a small gap or insinuation near the inner margin. The

endopod is a little larger than the exopod, the *appendix* is small and joins the endopod about the middle of the lamina. The exopod has 12 teeth on the distal margin. The exopod of the 3rd pleopod has a division, the endopod is larger and has a slight insinuation of the outer margin; there is a small tuft of setae on the outer distal angle of the peduncle. The 4th and 5th pleopods are rather narrow; the respiratory folds are numerous and well developed; the exopod of the 5th has 3 setuliferous lobes all outstanding.

The uropods are rather broad, moderately indurated, the inner ramus more so than the outer, granulate on the surface and reaching a little beyond the end of abdomen, the outer ramus reaching not so far as the inner, both are truncate and denticulate on the distal margins.

Length, 11 mm.

A female of this species has young well showing in the marsupium and the mouth parts are modified. The 7th segment of thorax is only slightly produced not covering the anterior division of abdomen, the posterior notch is very shallow and obscurely trilobed, but there is a very deep exit channel below. The uropods are reduced.

This species is from Garden Island, Western Australia, and the type is deposited in the Western Australian Museum.

Cassidinopsis tasmaniae, n. sp.

Plate liii., figs. 6-10.

Body glabrous, not very convex, with obliquely directed epimera visible from above, rather smooth or faintly granulate anteriorly, capable of folding together with the hinge about the 5th segment of thorax.

The head is small, there is a transverse furrow between the eyes which are rather small. The 1st segment of thorax is largest, considerably broader than the head; the 5 following segments are short, subequal in length, the 7th a little shorter. The anterior division of abdomen is short, projecting laterally as the segments of thorax. The posterior division of abdomen is convex, there is a median lobe with 2 converging submedian lobes not very salient, then the surface is gradually declivous to the pointed end, which has a shallow channel below but no notch.

The epistome is broad, the apex receding between the two basal antennular joints viewed from below.

The anterior parts of the 1st and 2nd antennular joints are visible from above; the distal angles of the 1st joint do not much embrace the 2nd, which is rather small, the 3rd being a little longer than it, the flagellum has its 1st joint longer than the rest, which are very short, numbering about 23. The antenna is very robust, the last 2 joints of peduncle are long, the last bent back, the flagellum has 20 short joints with the 1st the longest.

The mandibles have cutting plates nearly entire, the left one with a small secondary plate also entire. The spine rows bear few spines, the molars being quite near the cutting plates. The 1st maxilla has the distal spines of the outer ramus very much worn, the inner ramus bears 4 strong feather spines, and there is a distinct articulation at about half its length. The 2nd maxilla is robust, the 3 lobes reach to an equal level, the spines on the 2 more outer lobes are more robust than those of the inner lobe, whose attachment to the body of the limb is much more proximal. The maxilliped is rather slender, the lobe of the 2nd joint bears coarse spines, some of which are branched. The lobes of the palpal joints are rather crowded together.

The 1st leg is more robust than the rest, it is without spines, but the propodus has a tubercle on the inner side bearing 2 small teeth. The remaining legs are sparely spined but provided with furry pads on the usual joints.

The 1st pleopod has the peduncle rather short and crowded against the rami. The inner ramus is rather longer than broad and the outer about the same length; there are no marginal teeth as in *Cerceis*, etc., but there is an outstanding proximal spine as in so many Hemibranchiatae. In the 2nd pleopod the peduncle is also crowded up, the rami are similar to those of the 1st pair, the *appendix* is longer than the endopod and originates at its base. In the 3rd pleopod the endopod is very convex on its outer margin, the exopod has an oblique division line rather near the end, on the 4th and 5th pleopods the branchial rugae are very strongly developed, the outer ramus of the 4th with a proximal lobe has an increase of surface, the inner ramus also has large rugae and it is tipped with 2 plumose setae. The outer ramus of the 5th pleopod is also provided with a proximal lobe; distally there are 2 outstanding spinuliferous lobes with a small group on the inner side close to the division line.

The uropods are lamellar, the inner ramus the larger not reaching the end of abdomen, the outer ramus is ovate with a slight insinuation of the margin on the outer side near the end.

A female of this species is smaller and without visible brood. The mouth parts are normal, there is only a median lobe on the posterior division of abdomen, and this part is not so strongly pointed at the end. The 2nd antenna is not quite so robust. The 1st leg bears a few spines and there is no tubercle on the propodus.

Length of male, 18 mm.; breadth, 10 mm.

Collected by Dr. Torr at Port Arthur, Tasmania.

The type is in the South Australian Museum, C. 1258.

In 1908 (Trans. Roy. Soc. S. Austr., vol. xxxii.) I established a genus, *Moruloidea*, knowing very little of its affinity. I now believe it to be very close to the present genus, and may have to be united to it in the future. I am also of opinion that the genera *Cassidias*, Richardson, and *Euvallentinia*, Stebbing, are closely related to *Cassidinopsis*, Hansen, and that these 4 genera form a group at least with very close affinities.

Group PLATYBRANCHIATAE, Hansen.

Waiteolana, n. gen.

The body is narrow. The eyes are large. The epimera are uniform, vertical in direction, the 5th and 6th a little larger than the others. The abdomen is laterally contracted.

The basal antennular joints only very partially lodge in excavations of the head, the anterior portions of the 1st and 2nd joints project and are visible from above, as also projects the free apex of epistome.

The mandibles and maxillipeds are of the usual structure.

The legs are stout and uniform.

The endopod of 1st pleopod is nearly three times as long as broad. The 3rd pleopod has a division line on the exopod, both rami with many marginal plumose setae. The exopod of the 4th pleopod has a division with a few terminal setae. The exopod of the 5th is also divided with 4 lobes on inner margin scarcely salient. The endopods of 4th and 5th pleopods are more membraneous than their exopods, and there are vertical or oblique wrinkles but no transverse branchial folds.

It will be seen that this genus makes a new group in the Platybranchiatae.

I have pleasure in dedicating it to the Director of the South Australian Museum, Mr. E. R. Waite, who collected a single specimen of the genotype.

Waiteolana rugosa, n. sp.

Pl. 1., figs. 3-6.

The body is convex, glabrous, narrow, eroded with small sculpturings difficult to define, including a row of very small tubercles on the posterior margins of the segments of thorax. The abdomen is contracted and granulate.

The head is transverse with a strong ridge in front with a less defined one behind it. The eyes are large. The small rounded tip of epistome, which is free, and anterior portions of basal joints of antennules are visible from above. The segments of thorax have their exposed parts in relief and do not differ much in length, except the last, which is shortest. The epimera are vertical in direction, are not visible from above, and except the 1st are uniform and obtusely rounded below, that of the last reaching down as much as the preceding. The anterior division of abdomen projects a little convexly on its posterior margin; the suppressed segments are well marked. The posterior division is moderately domed and tapers behind to an obtuse point which carries a $\wedge$-notch; below there is a slight insinuation in the vertical direction (in the specimen, which is somewhat damaged, the notch is malformed).

The 1st antennular joint is strongly indurated, the 1st and 2nd joints have slight sulcations parallel to their anterior margins, the 2nd joint is half as long as the 1st, the 3rd is a little longer than the 2nd, the flagellum has 7 joints. The antenna is robust, its peduncular joints are laterally compressed, the joints of the flagellum are 7, which are strongly ciliated.

The epistome is conical and has a small labrum.

The left mandible has a strong entire incisory process, strong secondary plate, also spine row; the molar process is small.

The maxilliped has the 2nd joint rather large at the base, the plate is also broad, the palp is strong with lobes of joints moderately produced.

The legs are stout, rather short; there are some short teeth on merus, carpus, and propodus of 1st and 2nd pairs, the others are poorly spined, the dactyles are strong.

The pleopods as a whole are narrow.

The endopod of 1st pleopod is nearly three times as long as broad with a folded inner margin and subacute apex reaching beyond the exopod, the exopod is ovate and has a small proximal outstanding spine. The appendix of the 2nd pleopod is slender and longer than its endopod. The exopod of the 3rd pleopod has a division, the endopod is longer than broad with a thickened convex outer margin. Both rami of the 4th pleopod have a few distal plumose setae. The exopod of the 5th pleopod has 4 setuliferous lobes on the inner margin. The exopods of the 4th and 5th pleopods are divided. The endopods of 3rd, 4th, and 5th pleopods are membrane-like, somewhat wrinkled in oblique direction, but there are no branchial folds.

The uropod is indurated, the inner ramus is rather large and distally emarginate, the outer is small with a deep cleft.

Length, 8 mm.

One specimen, from "Thetis" Expedition Station 57.

The type is placed in Australian Museum, Sydney.

DESCRIPTION OF PLATES XXXVIII. to LIII.

Plate XXXVIII.

Fig. 1: *Sphaeroma quoyana,* male. Fig. 2: *id.,* lateral view. Fig. 3: *id.,* anterior region from below. Fig. 4: *id.,* left mandible. Fig. 5: *id.,* 1st maxilla. Fig. 6: *id.,* maxilliped. Fig 7: *id.,* 1st leg. Fig. 8: *id.,* 3rd leg. Fig. 9: *id.,* 5th leg. Fig. 10: *id.,* 7th leg. Fig. 11: *Sphaeroma terebrans,* anterior region from below. Fig. 12: *id.,* posterior division of abdomen, inferior view. Fig. 13: abdomen of dry specimen found with *S. terebrans,* Queensland.

Plate XXXIX.

Fig. 1: *Exosphaeroma intermedia,* n. sp., male. Fig. 2: *id.,* lateral view. Fig. 3: *id.,* anterior region from below. Fig. 4: *id.,* end of abdomen and uropod from below. Fig. 5: *id.,* 7th leg. Fig. 6: *id.,* 5th leg. Fig. 7: *id.,* maxilliped. Fig. 8: *id.,* 1st leg. Fig 9: *Exosphaeroma alata,* male, 1st leg. Fig. 10: *id.,* abdomen of female. Fig. 11: *id.,* anterior region from below, male.

Plate XL.

Fig. 1: *Exosphaeroma alata,* male. Fig. 2: *id.,* 7th leg. Fig. 3: *id.,* end of abdomen and uropod from below. Fig. 4: *Cymodoce bidentata,* male. Fig. 5: *id.,* side view of abdomen. Fig. 6: *id.,* end of abdomen and uropod. Fig. 7: *Cymodoce aculeata,* male. Fig. 8: *id,* anterior region from below. Fig. 9: *Cymodoce aspera,* anterior region from below. Fig. 10: *id.,* end of abdomen and uropod. Fig. 11: *id.,* side view of abdomen.

Plate XLI.

Fig. 1: *Neosphaeroma laticauda,* anterior region from below. Fig. 2: *id.,* end of abdomen and uropod. Fig. 3: *id.,* 1st pleopod, male. Fig. 4: *id.,* 2nd pleopod, male. Fig. 5: *id.,* 3rd pleopod. Fig. 6: *Neosphaeroma australe,* male. Fig. 7: *id.,* antennule, antenna, and epistome. Fig. 8: *id.,* end of abdomen and uropod, male. Fig. 9: *id.,* 1st pleopod. Fig. 10: id., endopod of 2nd pleopod. Fig. 11: *id.,* 3rd pleopod.

Plate XLII.

Fig. 1: *Cymodoce aspera,* female. Fig. 2: *Cymodoce gaimardii,* male. Fig. 3: *Cilicaeopsis ornata,* male. Fig. 4: *Cilicaea spinulosa,* male. Fig. 5: *Cilicaeopsis ornata,* end of abdomen and uropod from below. Fig. 6: *Cilicaeopsis halei,* female. Fig. 7: *Cilicaeopsis stylifera,* end of abdomen and uropod from below. Fig. 8: *Cilicaeopsis halei,* end of abdomen and uropod from below. Fig. 9: *id.,* antennule, antenna, and epistome.

Plate XLIII.

Fig. 1: *Cilicaea crassa,* male. Fig. 2: *id.,* end of abdomen and uropod from below. Fig. 3: *Paracilicaea stebbingi,* male. Fig. 4: *id.,* abdomen, female. Fig. 5: *id.,* anterior region from below. Fig. 6: *id.,* end of abdomen and uropod from below, male. Fig. 7: *id.,* 1st pleopod, male. Fig. 8: *Paracilicaea pubescens,* male. Fig. 9: *id.,* anterior region from below. Fig. 10: *id.,* end of abdomen and uropod, female. Fig. 11: *id.,* end of abdomen and uropod, male, immature.

Plate XLIV.

Fig. 1: *Cilicaeopsis corpulentis,* male. Fig. 2: *id.,* antennule, antenna, and epistome. Fig. 3: *id.,* right mandible. Fig. 4: *id.,* end of abdomen and uropod from below. Fig. 5: *id.,* 1st leg. Fig. 6: *id.,* 1st pleopod, male. Fig. 7: *id.,* 2nd pleopod, male. Fig. 8: *Cilicaeopsis obesa,* female. Fig. 9: *id,* maxilliped. Fig. 10: *id.,* anterior region from below. Fig. 11: *id.,* end of abdomen and uropod from below.

Plate XLV.

Fig. 1: *Cymodopsis latifrons,* male. Fig. 2: *id.,* anterior region from below. Fig. 3: *id.,* end of abdomen and uropod. Fig. 4: *id.,* 2nd leg. Fig. 5: *id.,* 7th leg. Fig. 6: *Cymodopsis plumosa.* Fig. 7: *id.,* anterior region from below. Fig. 8: *id.,* end of abdomen and uropod from below. Fig. 9: *id.,* 1st pleopod. Fig. 10: *Cymodopsis gorgoniae.* Fig. 11: *id.,* anterior region from below. Fig. 12: *id.,* side view of abdomen. Fig. 13: *id.,* end of abdomen and uropod from below.

Plate XLVI.

Fig. 1: *Cymodopsis crassa,* female. Fig. 2: *id.,* lateral view. Fig. 3: *id.,* anterior region from below. Fig. 4: *id.,* 1st maxilla Fig. 5: *id.,* 2nd maxilla. Fig 6: *id.,* maxilliped. Fig. 7: *id.,* 1st leg. Fig 8: *id.,* 7th leg. Fig. 9: *id.,* end of abdomen and uropod from below. Fig. 10: *id.,* 1st pleopod. Fig. 11: *id.,* 2nd pleopod. Fig. 12: *Cymodopsis wardi,* antennal region and epistome.

Plate XLVII.

Fig. 1: *Cymodopsis wardi*, female. Fig. 2: *id.*, end of abdomen and uropod. Fig. 3: *Cymodopsis albaniensis*, male. Fig. 4: *id.*, 1st leg. Fig. 5: *id.*, 5th leg. Fig. 6: *id.*, end of abdomen and uropod from below. Fig. 7: *id.*, epistome. Fig. 8: *Bregmocerella grayana*, 1st pleopod. Fig. 9: *id.*, 3rd pleopod. Figs. 10 and 11 represent a sphaeromid from Mast Head Island, Great Barrier Reef, 17 faths.; it was dry and partially rolled up, not lending itself to description—Col. A. R. McCulloch.

Plate XLVIII.

Fig. 1 (*Paracilicaea pubescens*, 2nd pleopod, young male ?). Fig. 2: *Cassidinella incisa*, antennae and epistomial region. Fig. 3: *id.*, end of abdomen and uropod from below. Fig. 4: *Dynamenella rubida*, male. Fig. 5: *id.*, epistome and antenna. Fig. 6: *id.*, end of abdomen and uropod. Fig. 7: *id.*, 1st pleopod. Fig. 8: *Haswellia anomala*, female. Fig. 9: *id.*, end of abdomen and uropod. Fig. 10: *Exocerceis nasuta*, male, posterior region. Fig. 11: *id.*, anterior region from below. Fig. 12: *id.*, 2nd pleopod.

Plate XLIX.

Fig. 1: *Cerceis ovata*, female. Fig 2: *id.*, anterior region from below. Fig. 3: *id.*, end of abdomen and uropod. Fig. 4: *id.*, 1st pleopod, male. Fig. 5: *id.*, 2nd pleopod. Fig. 6: *Haswellia juxtacarnea*. Fig. 7: *id.*, posterior region from below. Fig. 8: *Haswellia carnea*, anterior region from below. Fig. 9: *id.*, posterior region from below. Fig. 10: *id.*, posterior region from above, process of 7th segment of thorax removed. Fig. 11: *id.*, end of 7th segment of thorax from below.

Plate L.

Fig. 1: *Cerceis tridentata*, var. *intermedia*, male. Fig. 2: *id.*, anterior region from below. Fig. 3: *Waiteolana rugosa*, male. Fig. 4: *id.*, anterior region from below. Fig. 5: *id.*, 2nd pleopod. Fig. 6: *id.*, 1st pleopod. Fig. 7: *Isocladus howensis*, male. Fig. 8: *id.*, antennae and epistome. Fig. 9: *Isocladus ? laevis*, female, anterior region from below. Fig. 10: *id.*, end of abdomen and uropod from below. Fig. 11: *id.*, 1st leg. Fig. 12: *id.*, 7th leg.

Plate LI.

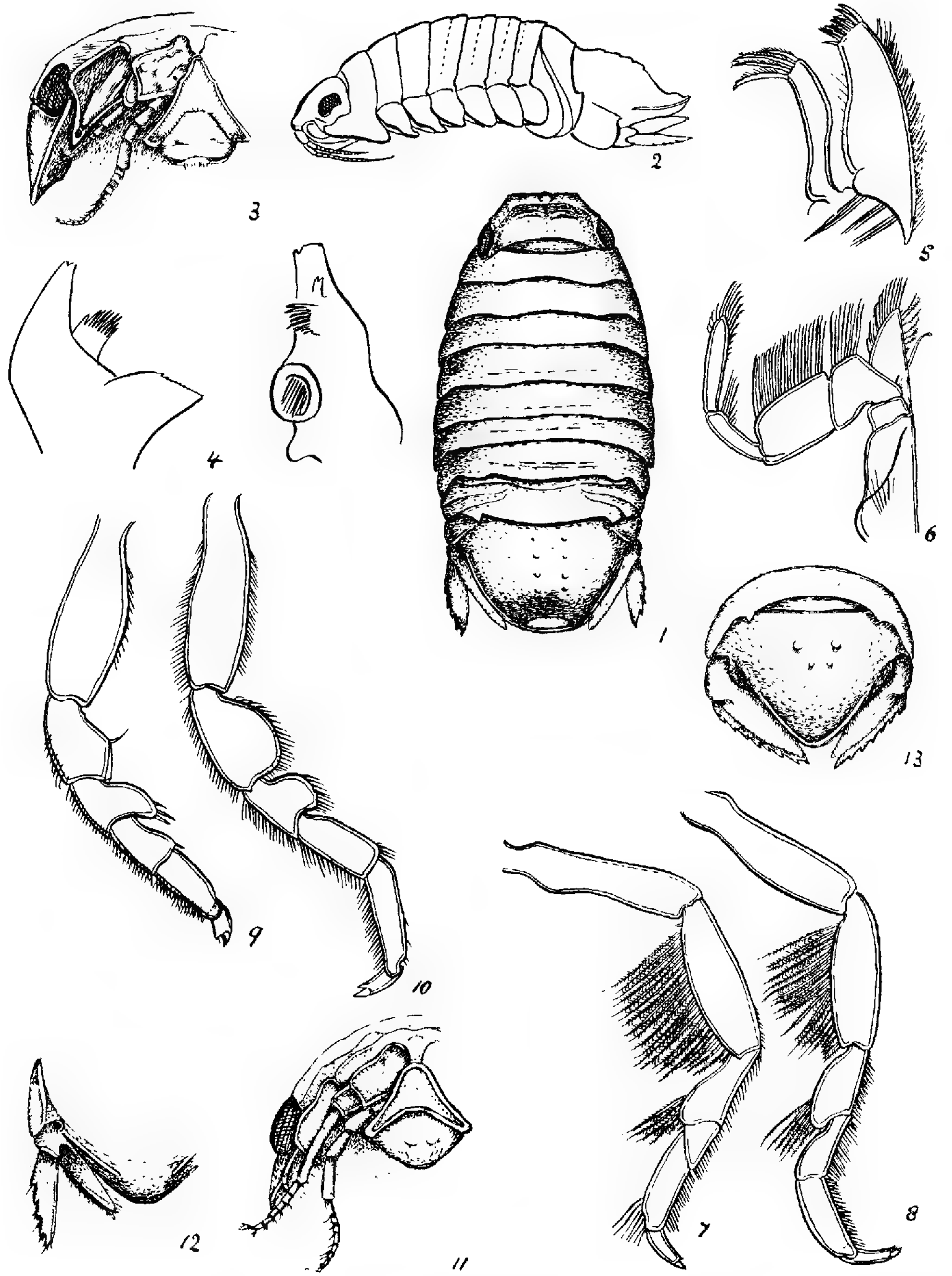
Fig. 1: *Neosphaeroma ? pentaspina*, male. Fig. 2: *id.*, anterior region from below. Fig. 3: *id.*, 5 joints of 1st leg. Fig. 4: *id.*, 1st pleopod. Fig. 5: *id.*, 2nd pleopod. Fig. 6: *Exosphaeroma alii*, male. Fig. 7: *id.*, epistome, 1st and 2nd antenna. Fig. 8: *Exosphaeroma bicolor*, 1st pleopod. Fig. 9: *Exosphaeroma alii*, 2nd pleopod. Fig. 10: *Exosphaeroma bicolor*, 7th leg.

Plate LII.

Fig. 1: *Exosphaeroma bicolor*. Fig. 2: *id.*, side view. Fig. 3: *id.*, uropods adjacent region from below. Fig. 4: *id.*, epistome and 1st and 2nd antennae. Fig. 5: *id.*, 2nd pleopod. Fig. 6: *Platycerceis hyalina*, male. Fig. 7: *id.*, uropod, etc. Fig. 8: *id.*, anterior region from below. Fig. 9: *id.*, 1st leg, female. Fig. 10: *id.*, 1st pleopod, female. Fig. 11: *id.*, 2nd pleopod, male.

Plate LIII.

Fig. 1: *Haswellia intermedia*. Fig. 2: *id.*, front view. Fig. 3: *id.*, anterior region from below. Fig. 4: *id.*, uropod, etc., from below. Fig. 5: *id.*, abdomen, etc., of female from above. Fig. 6: *Cassidinopsis tasmaniae*. Fig. 7: *id.*, anterior region from below. Fig. 8: *id.*, 1st leg of male. Fig. 9: *id.*, uropod and abdomen from below. Fig. 10: *id.*, 2nd pleopod.



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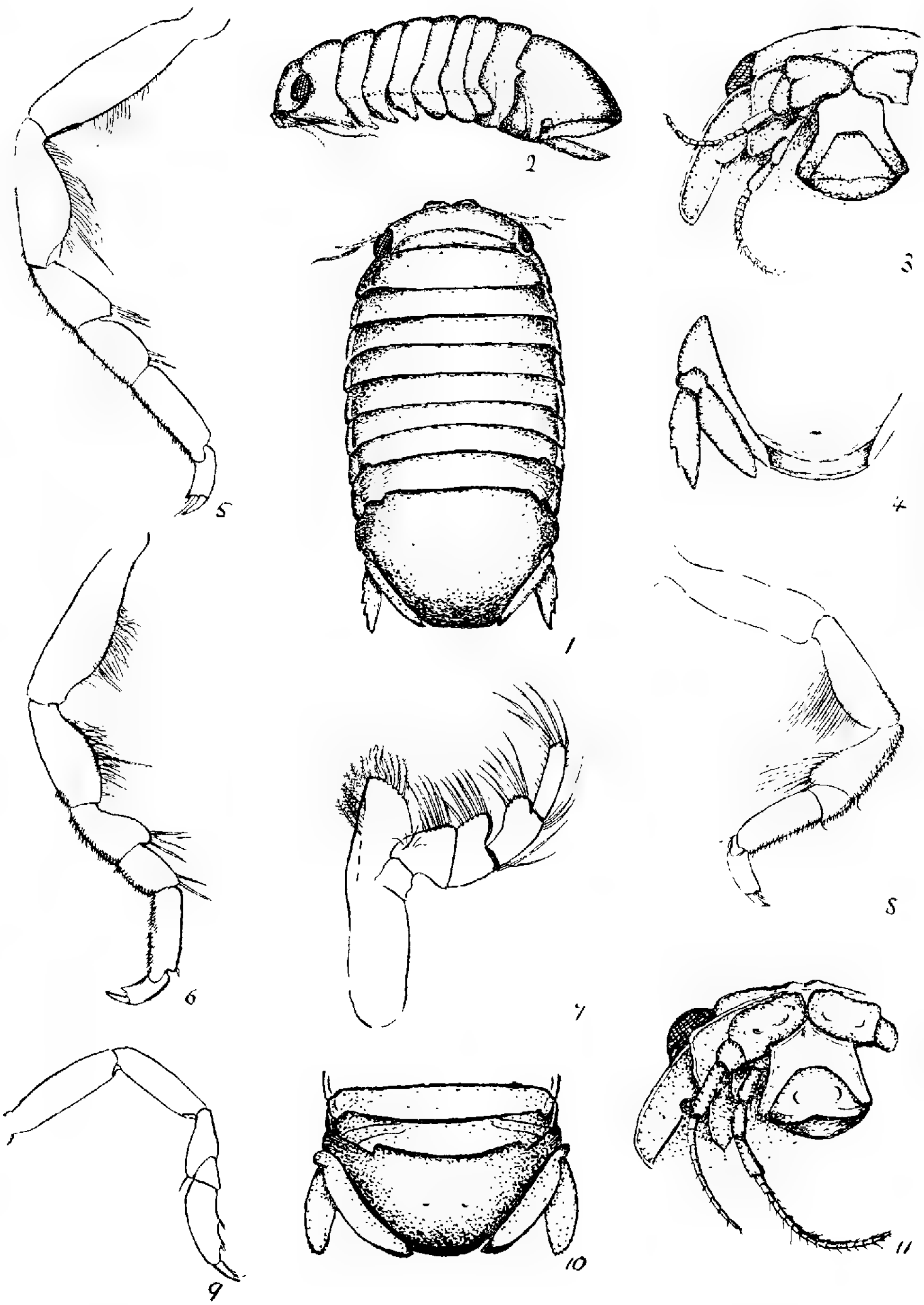

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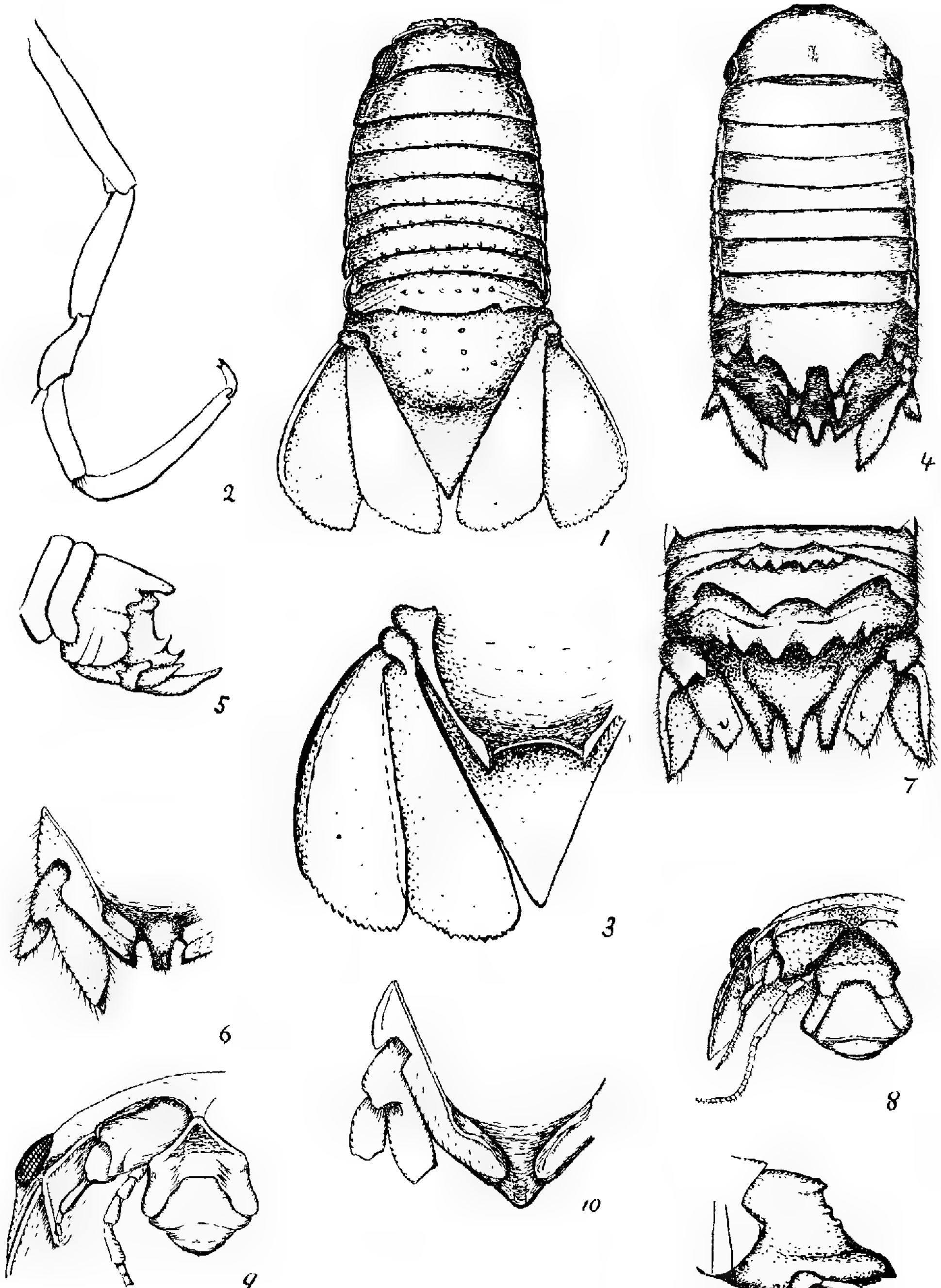

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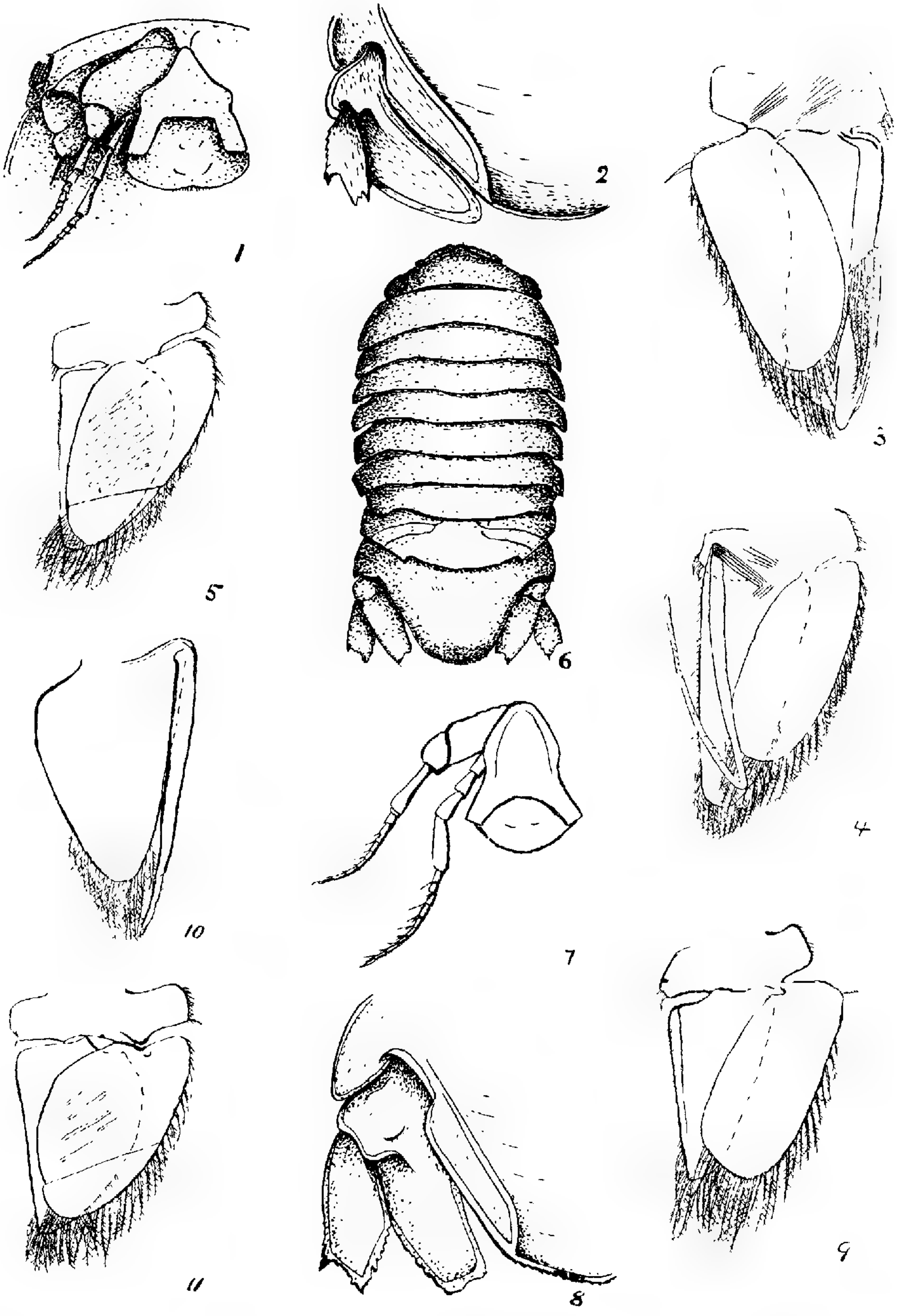

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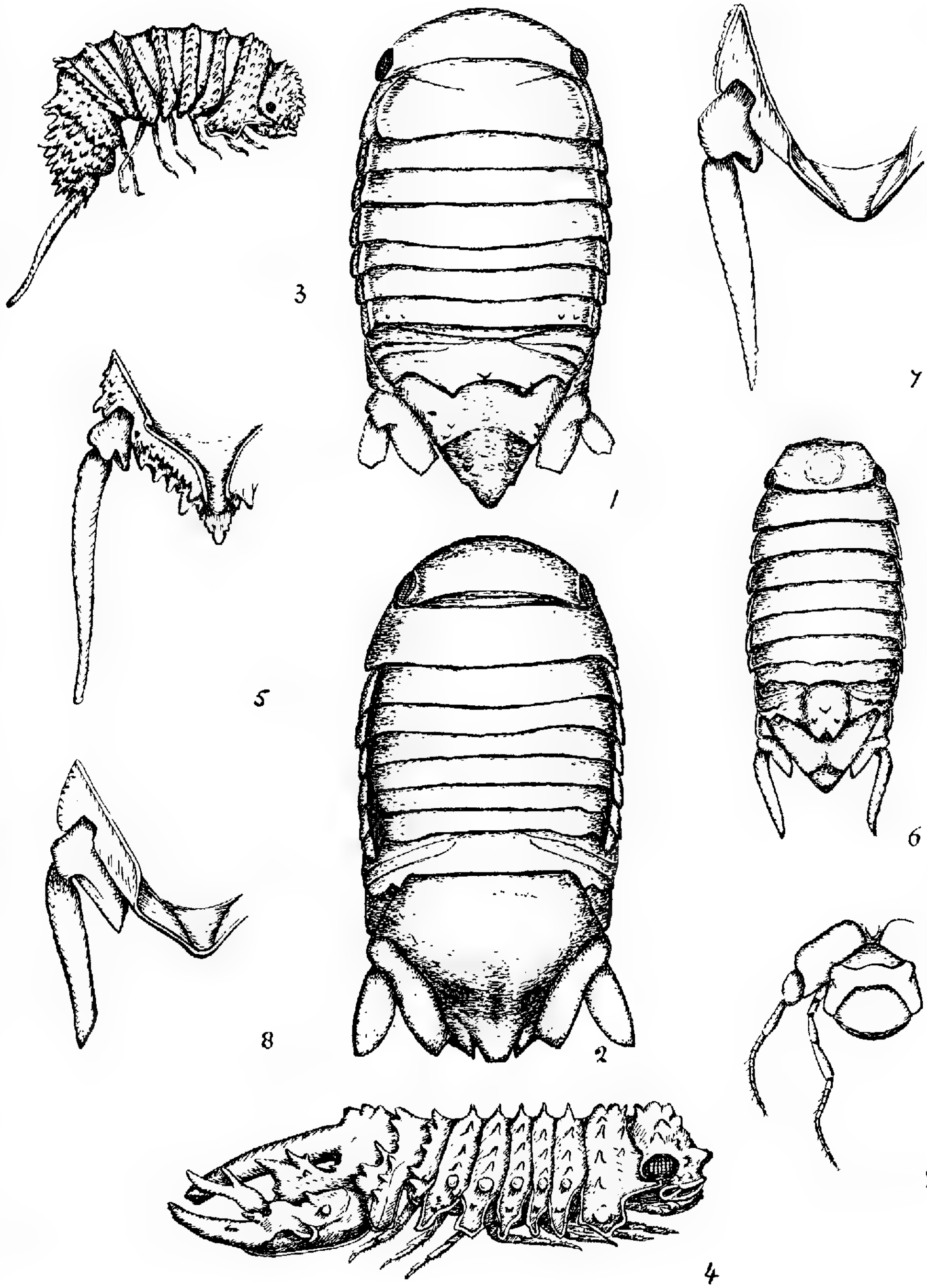

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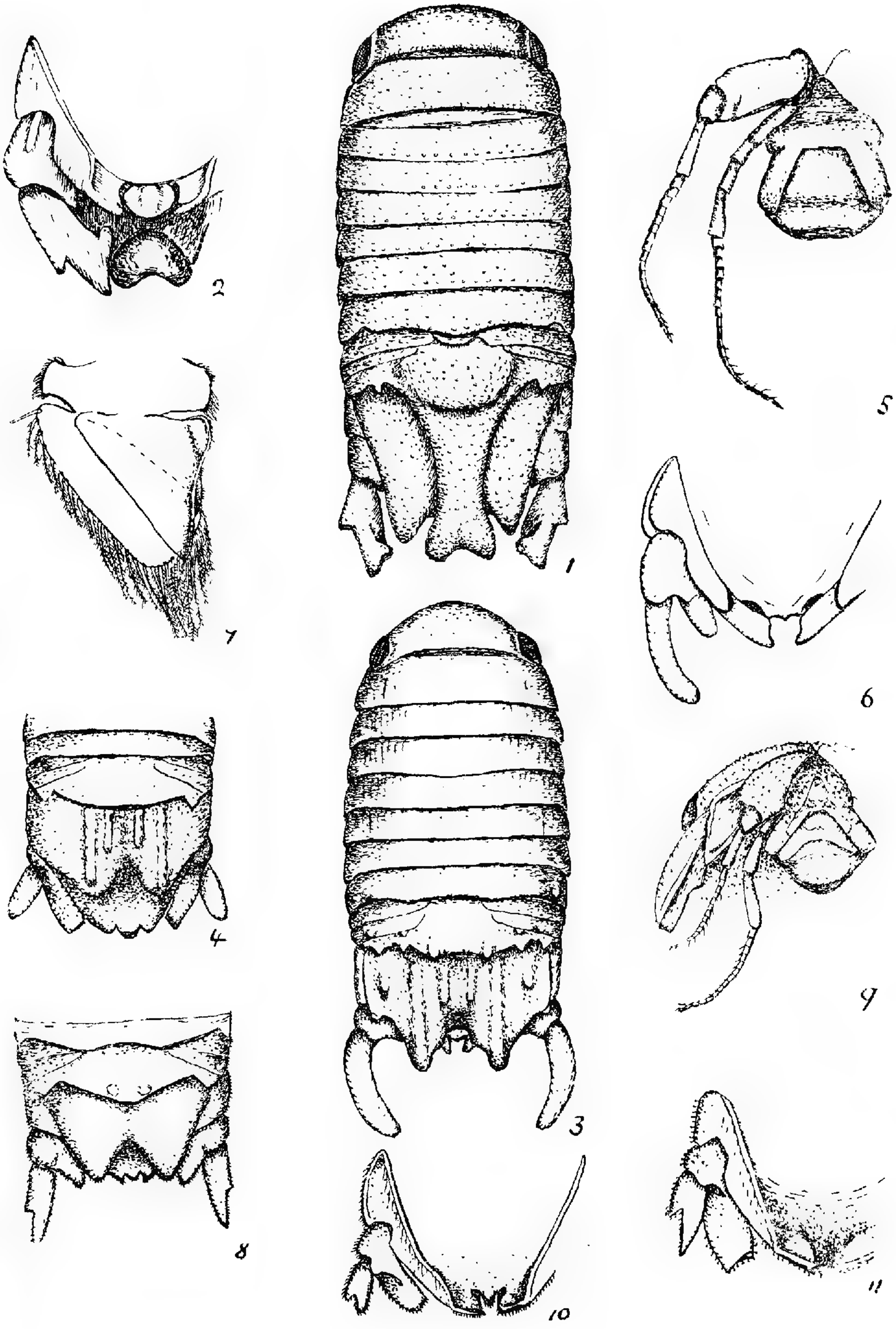

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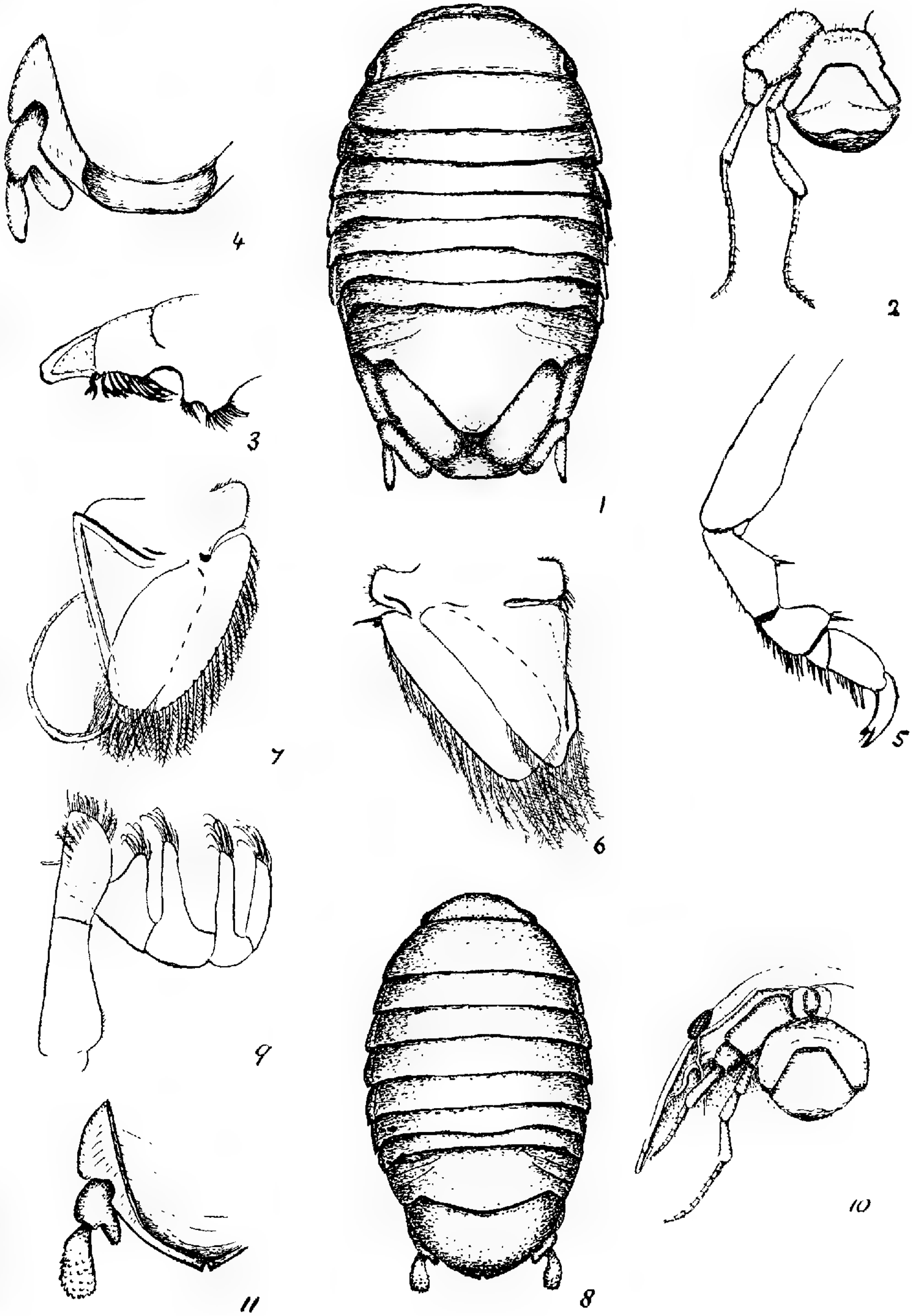

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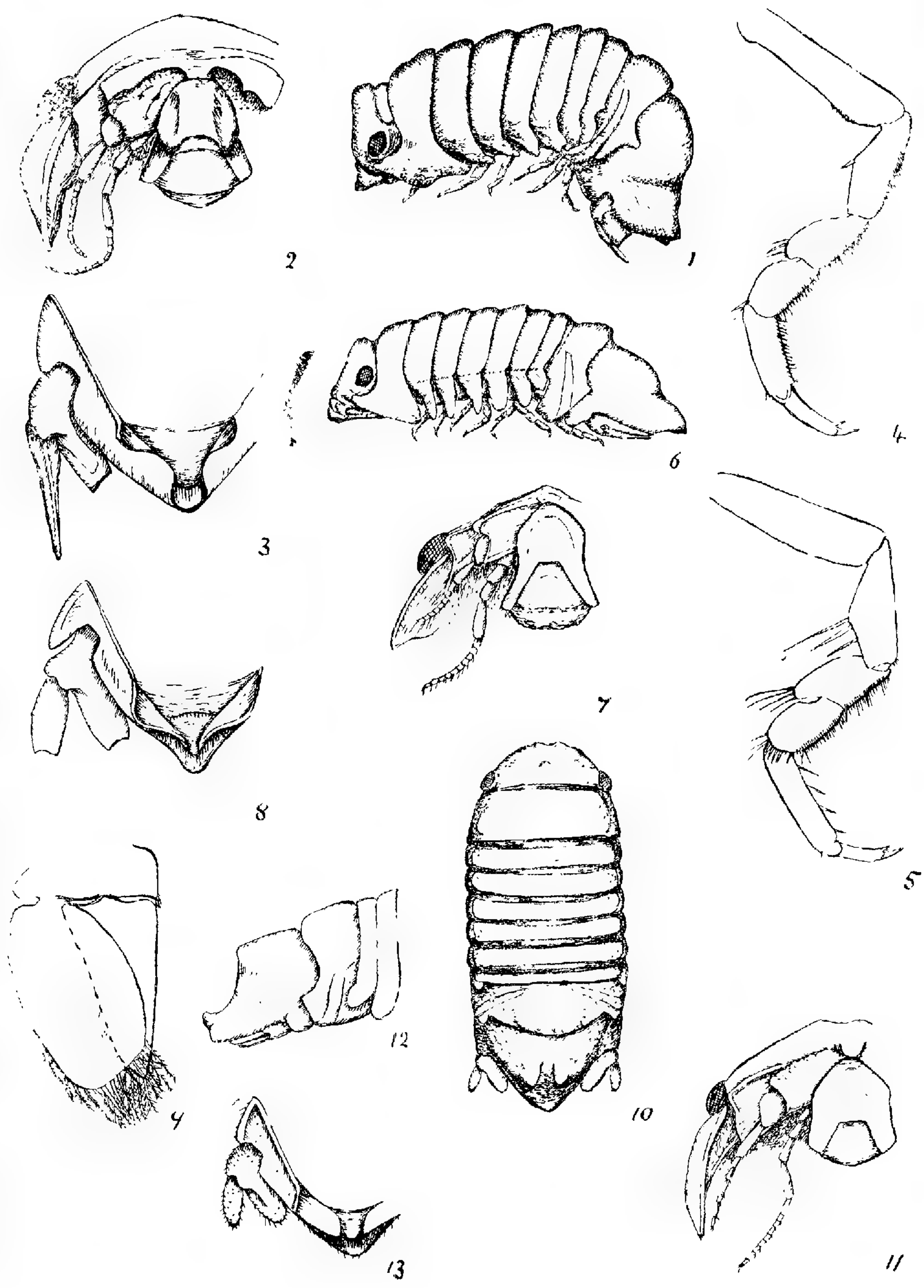

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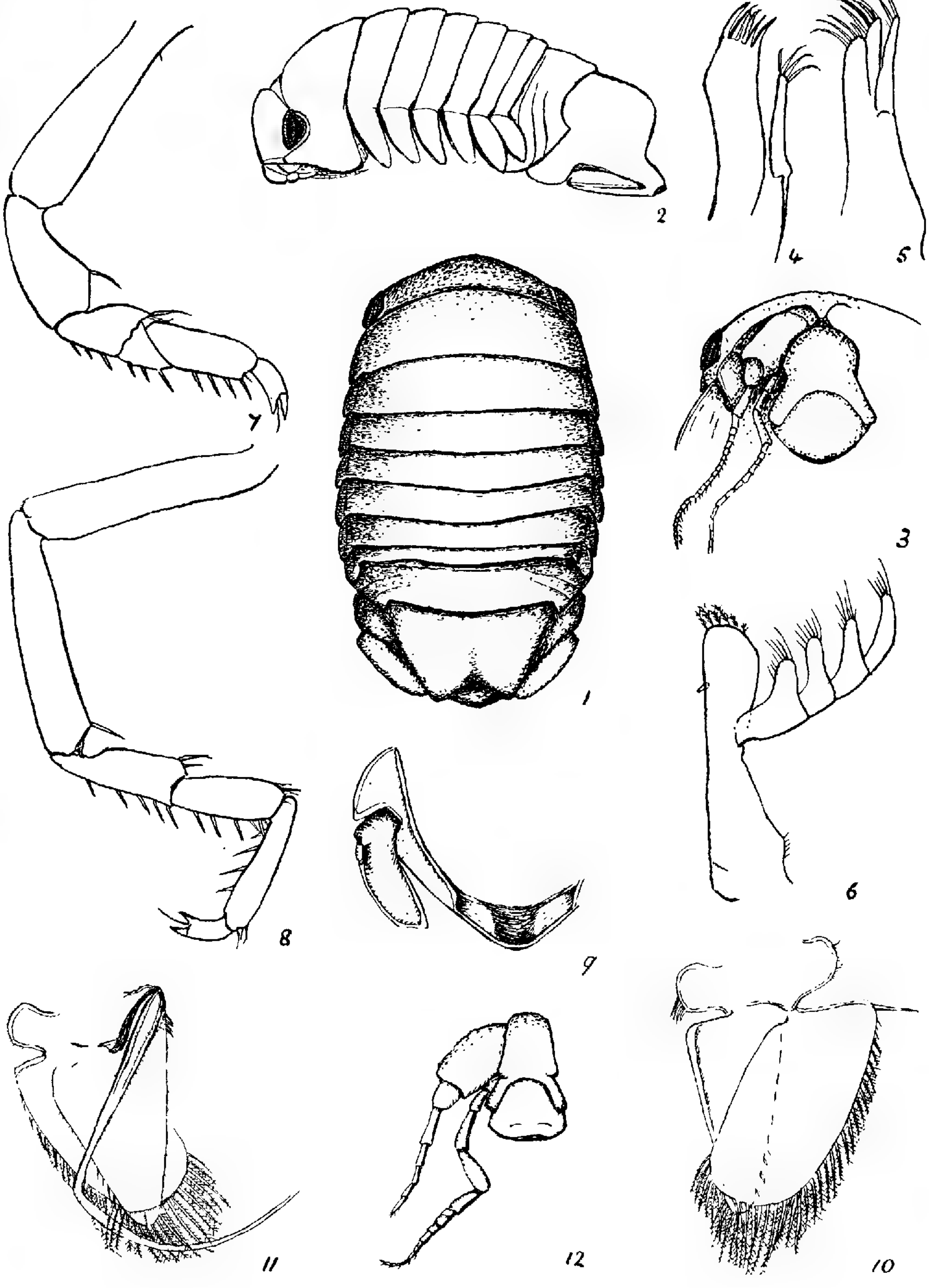

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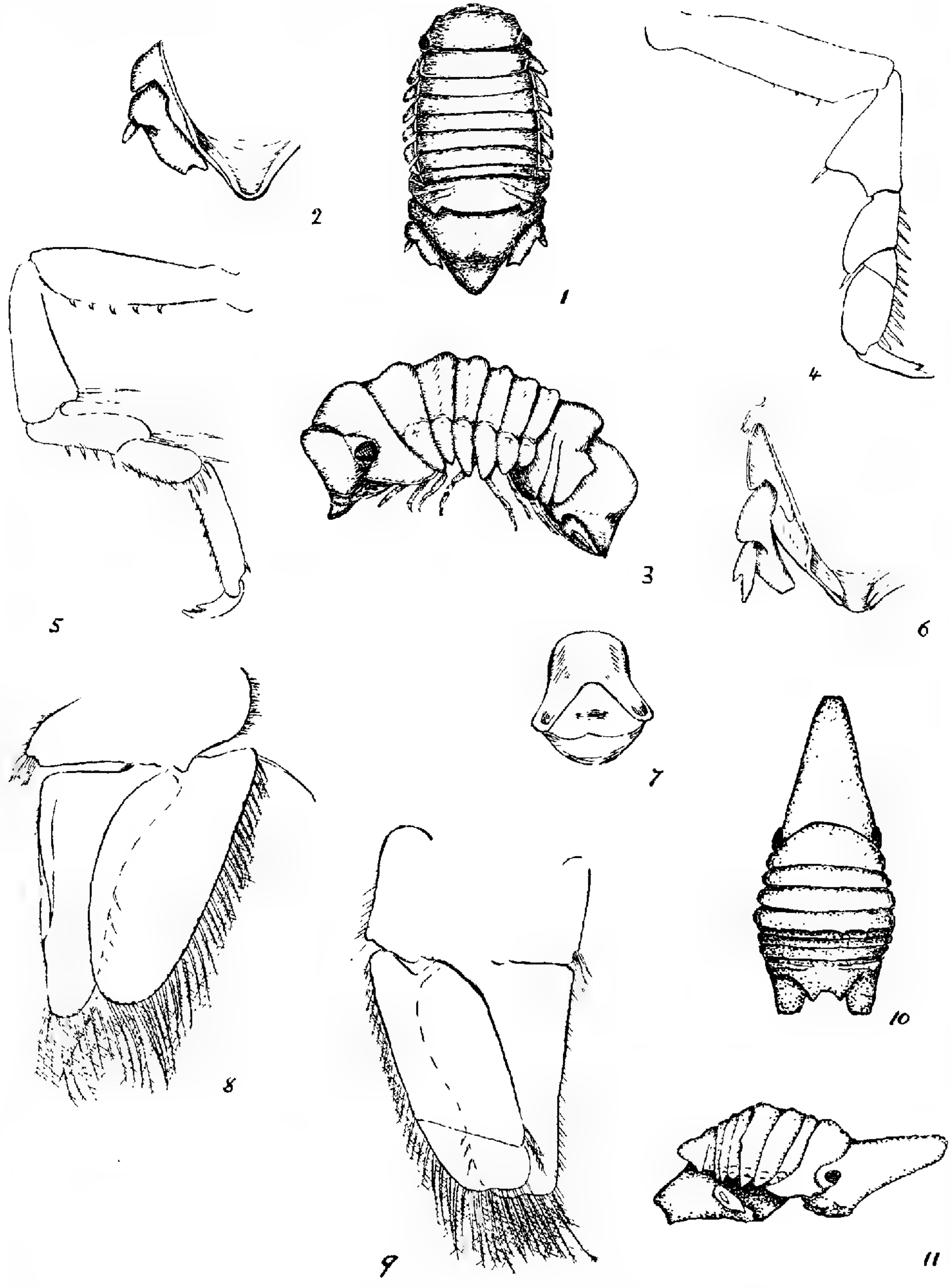

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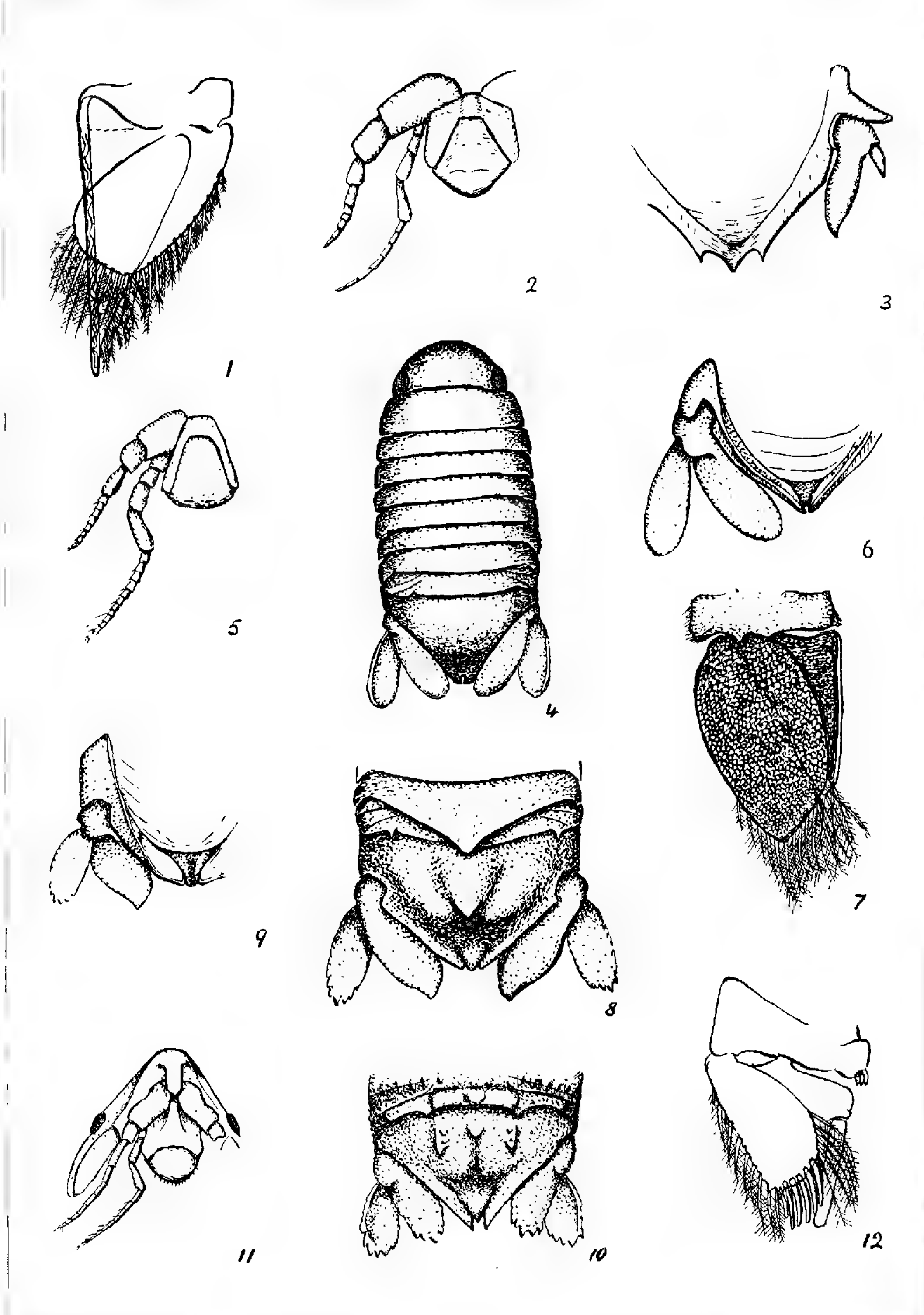

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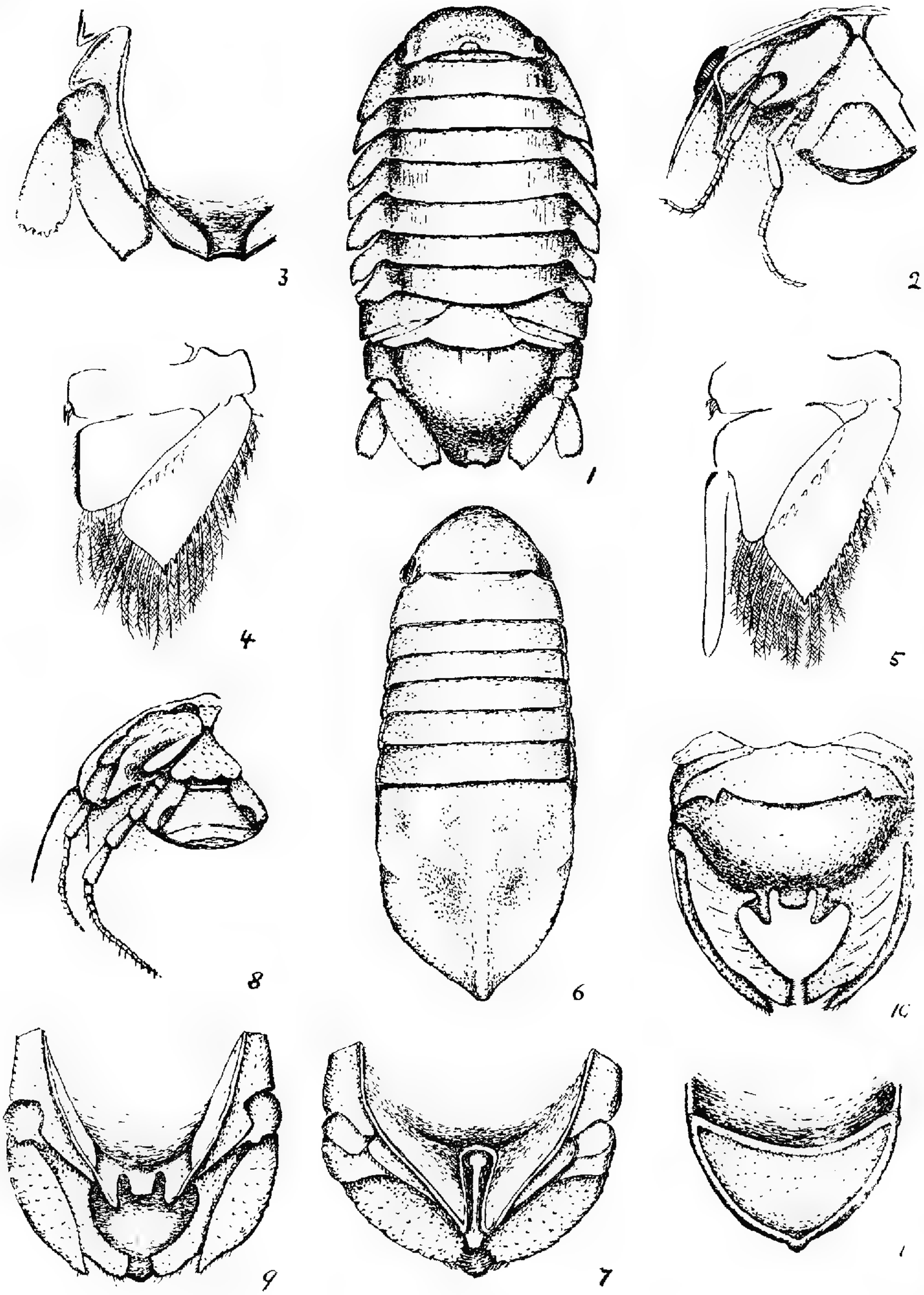

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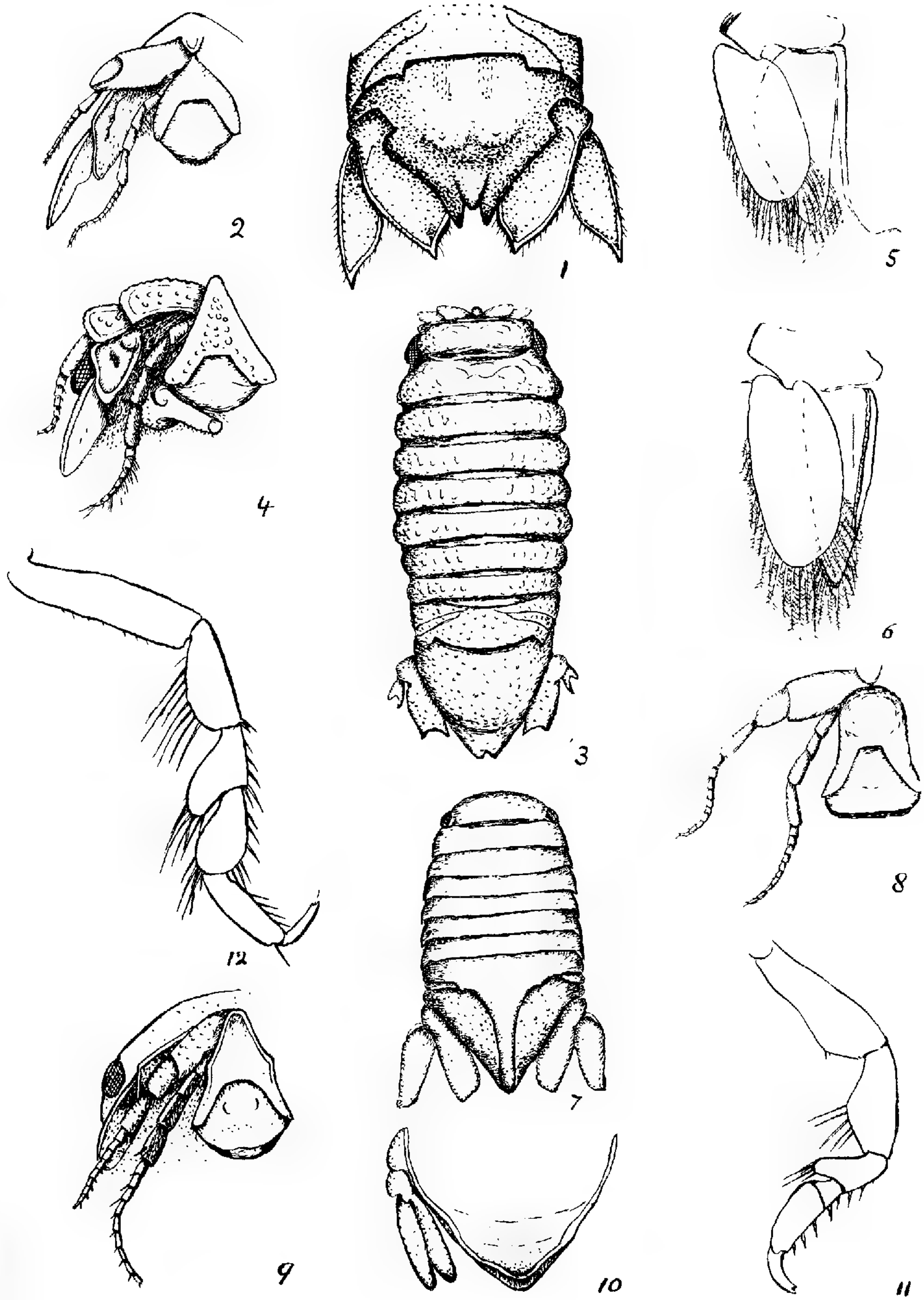

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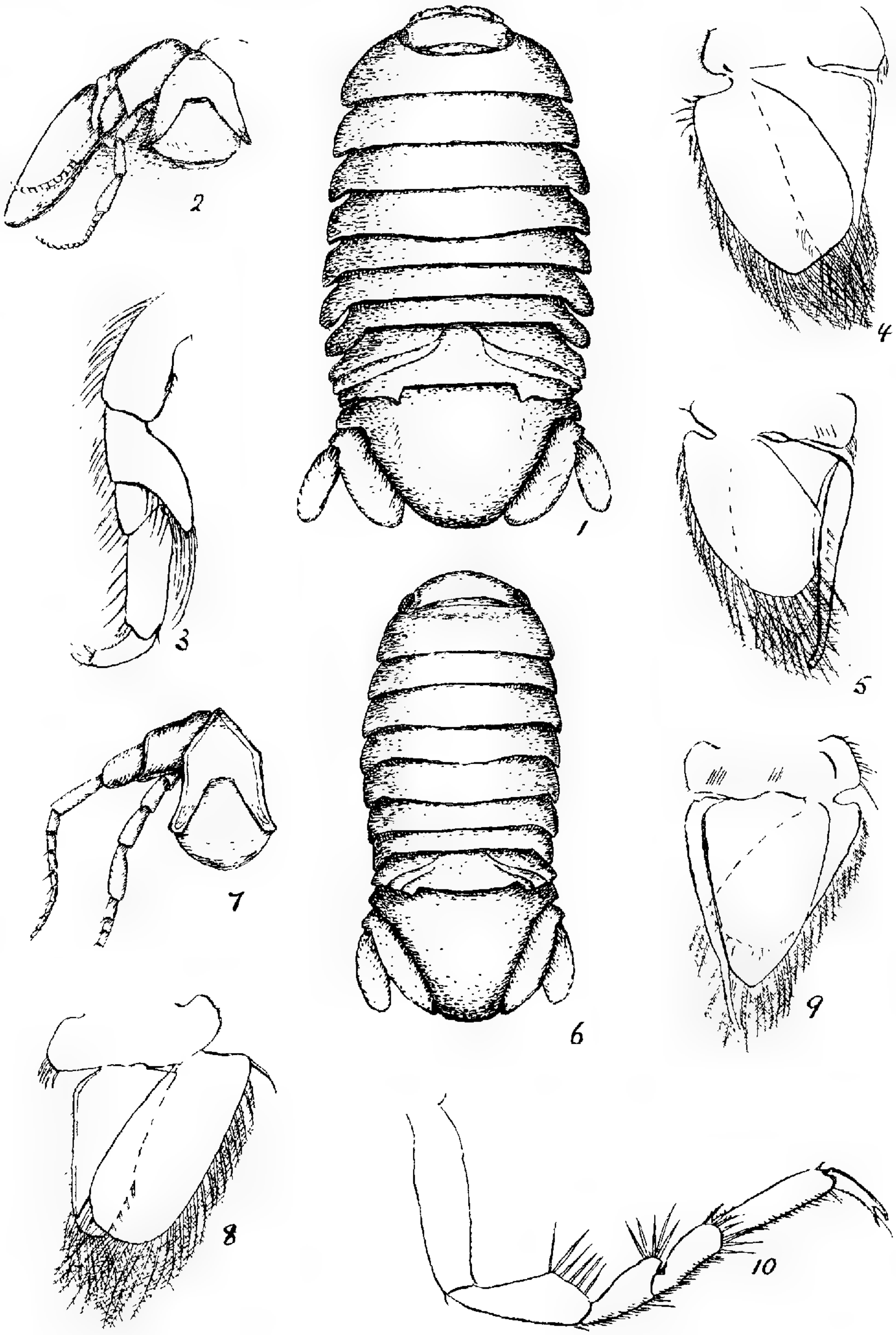

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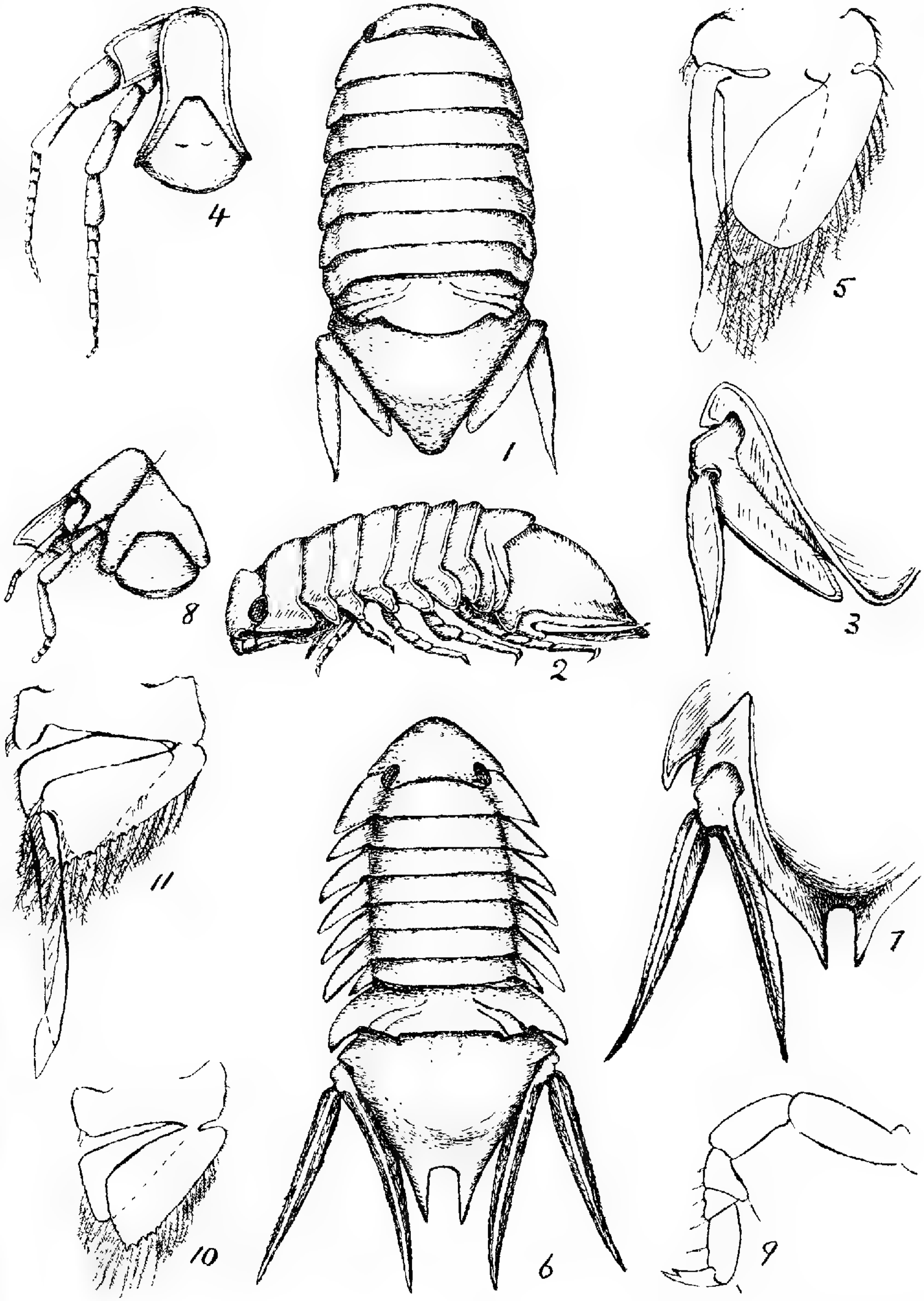

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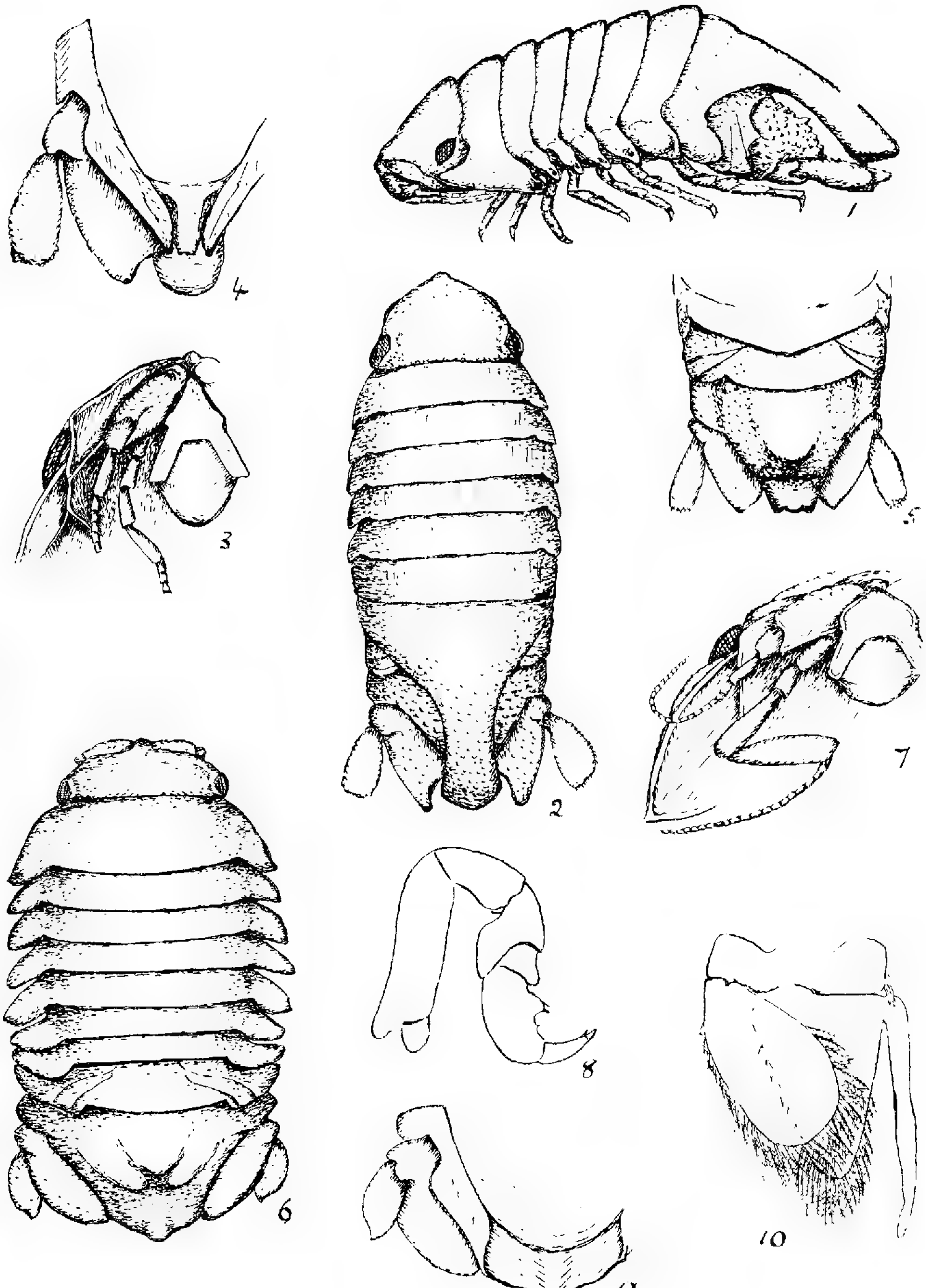

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AUSTRALIAN COLEOPTERA.—Part V.

By Albert H. Elston, F.E.S.

[Read October 14, 1926.]

CICINDELIDAE.

Cicindela jungi, Blackb.

Seven specimens, four males and three females, were taken by Mr. R. F. Kemp and the author last January on the Coorong near the 60-mile post from Meningie; they all agree very well with the description given of the above species by Blackburn.(1) The males have the green blotch on the elytra much paler than on the females, and on some specimens parts of the elytral markings are barely discernible or quite obliterated.

This species comes nearest to *C. saetigera*, Horn, but is distinguished from the latter chiefly by the punctuation of the elytral markings, which are very much finer, the pronotum and head more hairy, particularly between the eyes, the transverse wrinkles of the head and pronotum finer, and the scutellum not so acutely pointed posteriorly.

CLERIDAE.

Lemidia eborea, n. sp.

Nitid; black; eight spots on elytra white, antennae (club infuscated), parts of legs and abdomen testaceous. Upper surface sparsely clothed with moderately long dark hairs, under surface with shorter griseous ones. Head wide, between eyes flattened and without interocular foveae; densely, finely and rugosely punctured. Pronotum narrower than head, slightly longer than wide, sides abruptly and angularly dilated near the middle and with moderately deep transverse subapical and basal depressions; the derm is smooth, with shallow isolated punctures and a barely perceptible longitudinal carina in the middle. Scutellum very small and circular. Elytra much wider than base of prothorax and about three and a half times its length; sides of anterior third parallel, thence gradually dilated to near apex and then abruptly rounded; with moderately large seriate punctures, not very crowded and becoming smaller posteriorly. Under surface almost impunctate. Length, 5-5·5 mm.

Queensland: Bunya Mountains (H. Hacker). Type, in Queensland Museum.

On one specimen (presumably the male) the forepart of the face and the whole of the under surface of the anterior legs are testaceous. On each elytron there is a small transverse humeral spot at the base, a large irregularly shaped one at the middle, situated near, but not touching the margin and extending more than half-way across to the suture, a small elongate spot midway between the basal and median ones, and placed nearer to the suture than the lateral margin; the fourth is an oblique spot in front of the apex and almost touching the suture and lateral margin. The abdomen and anterior third of the intermediate and posterior legs are testaceous. A distinct characteristic is the entire absence of any foveae between the eyes. Its nearest congener is *L. simulans*, Blackb., from which it is easily distinguished by having subapical maculae on the elytra, upper surface more sparsely clothed with dark hairs, the sides of prothorax more angularly dilated near the middle, the upper surface of same smoother, and the spots on the elytra ivory white.

(1) Blackburn, Trans. Roy. Soc. S. Austr., 1901, p. 15.

Lemidia wilsoni, n. sp.

Nitid; upper surface black; antennae, part of face, prothorax (except subapical transverse impression, which is black) and parts of legs testaceous, two transverse bands on elytra red; under surface black with the prosternum and abdomen testaceous. Sparsely clothed with dark hairs, interspersed with pale ones, short and semierect on body, and much longer on legs. Head wide, interocular foveae shallow and divided from each other by a well-defined short carina; punctures small and shallow, scattered on top but more closely placed between the eyes. Pronotum about as long as wide, sides contracted anteriorly and posteriorly and evenly roundly dilated at the middle, with moderately deep subapical and basal transverse impressions; almost smooth, with small scattered punctures. Scutellum small and almost round. Elytra at base wider than prothorax and about two and a half times its length, the humeral angles slightly tuberculate, sides parallel up to the middle, then slightly roundly dilated to near apex, where they are somewhat abruptly rounded off; with very small, barely perceptible, seriate punctures. Length, 6 mm.

North-west Victoria: Linda (F. E. Wilson). Type (unique), in author's collection.

The anterior and intermediate tibiae and tarsi are mostly testaceous, the anterior femora are diluted with red; one transverse band on the elytra is situated in front of the middle and extends from the lateral margins (with which it touches) across to and touching the suture, the other is placed in front of the apex and extends from the lateral margin (with which it barely touches) across to and touching the suture, under each humeral angle is a small reddish spot. A very distinct species, its closest ally is, perhaps, *L. obliquefasciata*, Gorham, but is easily distinguished by being proportionately wider, red bands on elytra different, and the punctures on the elytra much finer; in fact, those on the present species are almost indiscernible.

Lemidia miniatula, n. sp.

Nitid; black; head, antennae, prothorax, narrow margin at base and apex of elytra, anterior and parts of intermediate legs and parts of abdomen reddish or reddish-yellow. Sparsely clothed with semierect ashy pubescence. Head with two interocular foveae moderately deeply impressed; very finely and somewhat closely punctured, the punctures more distinct on forepart than on top. Pronotum about as long as wide; sides contracted anteriorly and posteriorly, abruptly and roundly dilated at middle, with moderately deep subapical and basal transverse impressions; with a shallow round depression on each side near the lateral margin at the middle; the punctures minute, more noticeable near the lateral margins than elsewhere. Scutellum small, transverse and rounded. Elytra at base wider than prothorax and about three times its length; sides parallel up to the middle, then very slightly dilated to near apex, where they are individually rounded off; with moderately large, deep, closely placed, seriate punctures, less distinct at the base and apex. Length, 4·5 mm.

Victoria: Sea Lake (J. C. Goudie). Type (unique), in author's collection.

The red markings on the elytra are of a deeper tint than on the head and prothorax, the whole of the anterior legs is pale, except at the thighs, which are slightly infuscated, the under surface of the anterior legs is mostly reddish-yellow and the posterior legs are black, except the knees, which are reddish-yellow. This species differs from *L. flavipes*, Lea, which has the prothorax longer, more of the apex of elytra red, punctures on elytra more widely spaced and more sharply defined, the hind legs pale, and the basal band on elytra pale flavous. Somewhat resembles some of the varieties of *L. obliquefasciata*, Gorham, but may

be easily distinguished from that species by the upper surface being less hairy, the head reddish, nitid, and almost impunctate, interocular foveae not so deeply impressed, and the punctures on the elytra slightly deeper and more seriate.

TENERUS TELEPHOROIDES, Pasc.

This species is very variable in size, four specimens vary from 5 mm. to 8 mm. in length.

New South Wales; South Australia; Tasmania.

Phlogistus conspiciendus, n. sp.

Shining black; mouth parts, antennae, the tarsi and basal half of tibiae of anterior legs testaceous, all the femora with bluish reflections; clothed with rather long, upright hairs, more or less dark on the body and griseous on the legs, scutellum and a transverse fascia just behind the middle with densely arranged whitish hairs, and the apex of each elytron with a patch of dense, pale-golden hairs.

Head moderately wide and rather flat, with small rugose punctures very closely placed. Antennae somewhat slender and reaching to the base of prothorax. Pronotum about as long as wide, convex, roundly dilated near the middle, abruptly and strongly contracted at the base, before apex with a curved and at base with a straight, moderately deep, transverse impression and with a shallow, but nevertheless distinct, fovea at the middle and touching the subapical transverse impression; the punctures much larger than those on head and not densely arranged. Scutellum round. Elytra much wider than prothorax and about twice its length, sides almost parallel to near apex, where they are evenly rounded off, the humeral and sutural angles at the base tuberculate, the former more so than the latter; from the base to the postmedian fasciae with very large, deep, seriate and rugose punctures, behind the fasciae very glossy and almost impunctate. Legs robust, with the posterior femora reaching apex of elytra. Length, 12-12·5 mm.

Queensland: Bunya Mountains (H. Hacker). Type, in Queensland Museum.

A very distinct species with its postmedian transverse fasciae of silvery hairs and two apical maculae of golden hairs. Its nearest ally is *P. leucocosmus,* Elston, from which it is easily distinguished by its more robust appearance, the head more finely punctured and without a deep interocular fovea, the prothorax more globular and with the fovea in the middle smaller and not so deeply impressed, the scutellum densely covered with white hairs, and the punctures on the basal half of elytra comparatively larger and more rugose.

ADDITIONS TO THE FLORA OF SOUTH AUSTRALIA.

No. 24.

By J. M. Black.

[Read October 14, 1926.]

Gramineae.

Triodia Basedowii, E. Pritzel in Fedde Rep. 15:356 (1918). Distinguished from *T. pungens,* R.Br., by the longer flowering glume (6-9 mm. long), with the 3 lobes blunt instead of acute, and the young branches very woolly.—Flinders Range and Far North. The true *T. pungens* does not appear to have been found in our State, and the type comes from tropical Australia.

Stipa MacAlpinei, Reader in Vict. Nat. 15:143 (1899). Found by Professor J. B. Cleland on burnt country near the Rocky River, Kangaroo Island. The type comes from near Dimboola, in western Victoria, and it has also been collected in Western Australia. Our specimens are comparatively small, varying from 15 to 40 cm. high. Reader gives the height as "10 inches to 2 feet" (25-60 cm.). This species, which has not hitherto been found in South Australia, is distinguished by its apparently annual character, the lower leaf-sheaths covered with shining almost scaly hairs, the 2 very unequal outer glumes and the slender awn, 12-15 cm. long. Reader gives the length of the awn as 13-20 cm. Synonyms are *S. compressa,* R.Br., var. *lachnocolea,* Benth. (1878); *S. lachnocolea,* Hughes (1921).

Professor Cleland gives a tradition, obtained from an old resident of the island, that when the earliest colonists arrived at Nepean Bay in the winter of 1836, a bush fire had swept the adjoining country and this grass sprang up in great abundance. Its luxuriance led them to believe that they were looking at a fertile meadow, suitable for grazing and agriculture. This conviction strengthened their intention of making the principal settlement of the province on Kangaroo Island. Later in the year hot weather came and the grass withered and blew away. The official party, which arrived later, decided to remove the settlers to the mainland and fix the capital there.

Portulacaceae.

Portulaca intraterranea, n. sp. Herba robusta ascendens suculenta glabra 30-40 cm. alta, radice crassâ longâ obconicâ forsan perenni, foliis plerisque alternis oblongis planiusculis 8-20 mm. longis 4-6 mm. latis, pilis stipularibus paucissimis caducis, floribus solitariis vel paucis terminalibus intra folia summa sessilibus, sepalis 5-8 mm. longis, petalis flavis calyce subduplo longioribus inferne connatis, staminibus 25-30, styli elongati lobis 3, seminibus nigris granulatis.—*P. oleracea, L.* var. (?) *grandiflora,* Benth.

A complete specimen collected on Minnie Downs, near the Warburton River, by Mr. L. Reese, shows this to be a much stouter and more erect plant than *P. oleracea,* and perhaps perennial at base. The other characters in which it differs are the sepals twice as long, the petals much exceeding the sepals, and the stamens about twice as many as in *P. oleracea.* It will be observed that Bentham was doubtful as to the distinction being merely varietal. His varietal appellation cannot be carried forward, because *P. grandiflora,* Hook., is already the name of a popular garden species. *P. intraterranea* appears to have constantly only 3 style-branches, which are considerably shorter than the style proper. The stout stems and branches seem to remain green, while those of *P. oleracea* turn red, at least in the Far North. Both species are called "Pigweed."

Leguminosae.

Swainsona Morrisiana, n. sp. Planta verisimiliter annua pilis appressis centrifixis sparsim instructa, caulibus brevibus erectis vel ascendentibus, foliolis

plerisque 9 linearibus acutis 12-25 mm. longis, stipulis lineari-lanceolatis integris, floribus roseis 4-8 in racemo, pedunculo nudo puberulo 12-17 cm. longo folia multo superante, pedicellis calycem subaequantibus bracteâ multo longioribus, calyce nigri-pubescente 5 mm. longo, dentibus patentibus tubo dimidio brevioribus deltoideo-acuminatis, bracteolis minutis, vexillo 12 mm. lato rubri-venoso ecalloso, carinâ obtusâ sine sacculis lateralibus alis paululo breviore, stylo rigido oblique torto, barbâ basin dilatatam versus paulatim deminutâ, ovario pubescente, legumine ignoto.

Boolcoomatta Station (north of Olary, on Broken Hill Railway).

Named after the collector, Mr. Albert Morris, of Broken Hill, a keen student of botany, and one who has devoted special attention to the genus *Swainsona*. It is No. 1448.

Belongs to the section *Mesotrichae,* and differs from the true *S. stipularis,* F. v. M., in the narrow stipules, longer linear acute and always entire leaves, paler flowers, the keel without any approach to lateral pouches and the style curved to one side but not inflexed. It is a more slender plant and appears to be only annual.

Swainsona adenophylla, n. sp. Planta verisimiliter perennis, pilis appressis centrifixis conspersa; ramis a basi ligneâ usque ad 70 cm. longis; foliolis plerisque 7, linearibus, 8-20 mm. longis, supra viridibus puberulis, infra incanis, margine recurvis, apice 2 lobulis rotundatis conniventibus terminatis, lobulis inter se glandulam vel umbonem glabrum conspicuum semi-tegentibus; stipulis lanceolatis, integris; racemis laxis 8-20-floris, subpaniculatis, pedunculo nudo, puberulo, 4-10 cm. longo; floribus parvis, purpureis; calyce incano, $3\frac{1}{2}$ mm. longo, quam pedicellus longiore, dentibus subulatis tubo brevioribus; bracteolis minutis; bracteâ pedicello dimidio breviore; vexillo circiter 8 mm. longo et lato, callis duobus confluentibus praedito; carinâ obtusâ bi-sacculatâ, alis aequilongâ; stylo totâ longitudine barbato, supra curvaturam recto et tenui, basin versus incrassato, conico; legumine vix maturo cylindrico, 15-20 mm. longo, circiter 4 mm. lato, puberulo, reticulato, secus suturam profunde impresso, stylo incurvo terminato.

Finniss Springs (between Lake Eyre and the Marree-Oodnadatta Railway), coll. Francis D. Warren. Mr. Warren states in a note:—"Clay watercourses or crabholes; purple vetch, splendid fattening feed; very beautiful when in flower."

A very distinct species owing to the peculiar leaflets, which terminate in 2 small rounded lobes. These lobes, as well as the margins of which they are the upward continuation, are connivent or incurved, especially when dry, and thus somewhat conceal a large brown gland or glabrous swelling which lies between them at the summit of the leaflet. The leaflets might equally well be described as deeply notched at summit, with a gland just below the notch. The new species belongs to the section *Mesotrichae,* and has the small flowers of *S. microcalyx,* but is a much larger and stouter plant, the standard with 2 small confluent calli and the keel 2-pouched, both of which characters are absent in *S. microcalyx,* whose leaves are flat, cuneate and without any terminal gland.

Indigofera Basedowii, E. Pritzel in Fedde Rep. 15:356 (1918). This name must replace *I. longibractea,* J. M. Black, in Trans. Roy. Soc. S. Austr. 47:369 (1923), on the ground of priority.

I. leucotricha, E. Pritzel, *l.c.* 357 (1918). This new species was described from specimens collected by Strehlow at Hermannsburg, C.A. It is a white-tomentose form with smaller snowy leaflets and dark-brown calyxes like those of the preceding and has hitherto been placed under *I. brevidens,* Benth. It is perhaps the same as var. *uncinata,* Benth. It occurs in the Flinders Range, between Blinman and Beltana and northward to Oodnadatta; also at Depot Glen in the N.W. corner of New South Wales, and along the Finke River in Central Australia.

Malvaceae.

Hibiscus intraterraneus, described by me in these Trans., 1925, p. 274, appears to be a form of *H. brachychlaenus,* F. v. M., with more deeply divided leaves than those described by Mueller.

Frankeniaceae.

I was regretfully unable to incorporate in Part 2 of the Flora of South Australia two new species of *Frankenia* described by T. A. Sprague in the Kew Bulletin, 1925, pp. 426-7, because they did not appear to me sufficiently distinct from *F. serpyllifolia,* Lindl. One of these is *F. flabellata,* Sprague, from the Frome River, near Marree. It is differentiated from *F. serpyllifolia* by the shorter calyx-lobes with subhyaline margins, the fan-shaped petals and the filaments subulate instead of linear. The other is *F. connata,* Sprague, from Leigh's Creek, described as differing from *F. flabellata* in the filaments adnate to each other and to the petals, larger and scarcely toothed petals, longer stigmas and the margins of the leaves more revolute. It is true that the petals vary somewhat in the breadth of the lamina, which is always more or less denticulate at summit, but the breadth varies even on the same plant. Much more striking to the eye is the variation of colour in the petals of our South Australian forms of *F. serpyllifolia,* which ranges from pale pink (drying white) to bright red. The leaves vary remarkably in breadth on the same plant and the revolution of the margins is always more pronounced in dried specimens. As regards *F. connata,* I made drawings of details from the fresh co-type of the specimen forwarded by me to Kew and on which Mr. Sprague founded his new species, and the drawing of the stamen shows the filament quite free in all its length. My field-note on the same specimen says:—"Petals quite distinct at first; later on claws show tendency to cohere." This appears to be a peculiarity of *Frankenia,* and I feel sure that adhesion of the filaments to each other or to the petals, or cohesion of the claws of the petals, cannot be correctly determined in dried specimens. I doubt whether these unions ever occur in the living plant. Mr. Sprague considers that the only specimen of true *F. serpyllifolia* from South Australia is one collected by R. Helms at Cootanoorinna (Arkaringa Creek) in 1891. The type came from the Nive River, Queensland.

Loganiaceae.

Logania recurva, n. sp. Frutex erectus glaber circiter 1 m. altus, foliis lanceolatis vel lineari-lanceolatis 2-4 cm. longis 3-8 mm. latis utraque extremitate angustatis sed sessilibus et semi-amplexantibus margine recurvis vel revolutis secus nervum medianum supra sulcatis, cymis densis planiusculis pedunculatis paniculam longam angustam basin versus foliosam formantibus, calyce 1½ mm. longo ciliolato, corollâ 4 mm. longâ faucibus annulo piloso instructâ, tubo glabro, capsulâ circiter 5 mm. longo.—*L. longifolia,* R.Br., var. *subsessilis,* Benth.

Mount Lofty Range; Ardrossan, Y.P. Differs from *L. vaginalis* (Labill.), F. v. M., in the lanceolate sessile and half-clasping leaves with revolute margins, sometimes so much so as almost to conceal the midrib. *L. vaginalis,* which includes *L. latifolia* and *L. longifolia,* R.Br., has ovate-acuminate leaves, shortly petiolate and without recurved margins; the corolla-tube is minutely pubescent inside, while that of *L. recurva* is glabrous.

Logania insularis, n. sp. Fruticulus gracilis, ramis hispidulis, foliis glabris ovatis vel ovato-oblongis 4-6 mm. longis 2½-3 mm. latis crassis obtusis planiusculis margine recurvis brevissime petiolatis, cymis brevibus paucifloris, calyce vix 1 mm. longo ciliolato, corollâ fere rotatâ 4 mm. diametro tantum faucibus minute pilosâ vel papillosâ, capsulâ 3-4 mm. longâ.

Cape Borda, Kangaroo Island. Very distinct from our other species, with small leaves and flowers few and small; seems nearest to the Western Australian *L. buxifolia,* F. v. M., which is quite glabrous, with rather larger leaves without recurved margins.

Convolvulaceae.

Ipomoea lonchophylla, n. sp. Planta verisimiliter annua partibus junioribus hispidula demum glabrescens, caule ascendente non volubili, foliis

lanceolatis integris acutis 3-10 cm. longis ciliolatis, petiolis 1-6 cm. longis, floribus solitariis raro geminis in pedunculis 3-5 mm. longis prope medium bibracteatis. sepalis 10 mm. longis ovatis longe acuminatis conspicue ciliatis ceteroqui glabris, corollâ angustâ cylindricâ calycem paulo excedente, lobis apice ciliolatis, capsulâ globosâ calycem subaequante; seminibus 4-5 mm. longis fusco-puberulis.

Far North, from Marree and the Alberga River to north of Cooper's Creek.—Central Australia. Appears to have been considered a form of *I. heterophylla*, R.Br., from which it differs in the clothing, the longer lanceolate entire leaves, the larger and merely ciliate sepals, the absence of bracteoles close to the calyx, etc.

SOLANACEAE.

Nicotiana excelsior, n. sp. *N. suaveolens*, Lehm., var. *excelsior*, J. M. Black, in Trans. Roy. Soc. S. Austr., 39:835, t. 70 (1915). I think this plant is worthy of specific rank. It is distinguished by its height, the stem-leaves decurrent by 2 long broad wings and by the much larger flowers.

SCROPHULARIACEAE.

Veronica parnkalliana, n. sp. Herba perennis erecta vel ascendens 30-40 cm. alta, nodis ramorum lineis crispo-pubescentibus a basi foliorum decurrentibus signatis, foliis oppositis oblanceolatis fere glabris grosse paucidentatis vel integris sessilibus 1-3 cm. longis, racemis laxis 5-20-floris cum pedunculo glabro 8-20 cm. longis paniculas saepe corymbosas formantibus, pedicellis 6-10 mm. longis, calycis segmentis lanceolatis circiter 4 mm. longis, corollâ calyce duplo longiore, lobis ovatis, capsulâ compressâ parum emarginatâ calyci subaequilongâ 5-7 mm. latâ loculicide dehiscente.

Near Port Lincoln, coll. H. H. D. Griffith, Oct., 1909. Differs from *V. gracilis* and *V. distans*, R.Br., in the long many-flowered paniculate racemes, the obtuse leaves and the usually more rigid branches. Parnkalla was the name of the native tribe, now practically extinct, which inhabited the greater part of Eyre Peninsula when the first colonists arrived.

MYOPORACEAE.

Eremophila MacGillivrayi, n. sp. Frutex robustus 2-3 mm. altus, ramis foliis calycibusque dense et arcte stellato-incanis, foliis alternis albis lineari-lanceolatis $1\frac{1}{2}$-4 cm. longis 4-6 mm. latis crassiusculis planis mucronatis in petiolum brevissimum angustatis caducis cicatrices prominentes relinquentibus, pedunculis solitariis 8-12 mm. longis angulatis apicem versus incrassatis, calycis 3-4 mm. longi segmentis ovato-lanceolatis acutis crassis basi non imbricatis fructiferis 10 mm. longis, corollâ rubellâ 25 mm. longâ extus sparse stellato-pubescente intus glabrâ, lobis 2 supremis subacutis usque ad medium connatis, lobis lateralibus obtusis, lobo infimo oblongo ad circiter trientem corollae soluto reflexo, staminibus plus minusve exsertis, filamentis parce pilosis, ovario styloque pilis ramosis dense lanatis, ovulis 2 subcollateralibus in quoque loculo, fructûs immaturi pericarpio 4-valvi lanato, endocarpio osseo.

Commemorates Dr. Wm. D. K. MacGillivray, of Broken Hill, who collected specimens near Cordillo Downs, S.A. (north of Cooper's Creek), in Sept., 1922. Later the shrub was found by Professor J. B. Cleland in the same locality and on Arrabury Station, across the border in Queensland. It has also been collected in the same state on Nockatunga Station, near the Wilson River.

This species is difficult to place in the genus, as it has the thick tomentose calyx, with the segments valvate at base, which characterises Bentham's section *Eriocalyx*, but the corolla is that of section *Stenochilus*, and the ovules are only 2, or very rarely 3, in each cell of the ovary. Its white leaves and branches make it easy to recognise.

THE ABORIGINES OF SOUTH AUSTRALIA: NATIVE OCCUPATION OF THE EDEN VALLEY AND ANGASTON DISTRICTS.

By Paul S. Hossfeld, B.Sc.

[Read October 14, 1926.]

During the months of July and August of this year, the writer was engaged in a geological survey of the district. Investigations resulted in the discovery of a number of native camp sites, several decorated caves, and of at least one burial ground (fig. 1). In addition, all information obtainable from old residents and records has been collected, and is presented in this paper.

As far as could be ascertained, no records exist of the native occupation of this part of the Mount Lofty Ranges. It is, therefore, of extreme importance that such facts as can still be obtained should be placed on record before their collection becomes an impossibility.

The items discussed are:—

1. Mural Decorations.
2. Camp Sites.
3. Burial Grounds.
4. Information obtained from Local Residents.
5. Native Place Names.

1. Mural Decorations.

Numerous caves and rock shelters exist on Sections 139 and 212, Hundred of Jutland, but only three of them were found to contain drawings. These caves have been produced by the weathering and subsequent removal of pegmatized mica schist. As the drawings in each cave are of a different type, the three occurrences will be described separately and referred to as A, B, and C.

Cave A.

This is much the largest of any seen in the district. It is situated on the south side of the River Marne, or South Rhine, on Section 139, Jutland, about 40 feet above the level of a waterfall. The river is perennial, and breaks through the rocks in a short, but steep, rocky gorge. The cave itself is inaccessible except from the front, and even here the approach is somewhat difficult. It consists of an inner and an outer chamber. The front is formed by a deep, overhanging roof with a width parallel to the river of at least 40 feet, and is 20 feet deep and 10 feet high. In the rear wall of this recess, a small triangular hole, large enough to admit a stooping man, leads to the inner cave, a chamber of much larger dimensions, with an approximate length of 58 feet and average width and height of 12 feet. This inner cave has a more or less horizontal roof, and a floor which rises rapidly towards the back of the chamber. The irregular sides converge towards the junction of floor and roof, giving to that part of the cave a pointed shape. The drawings are restricted to the rear wall of the outer chamber, the other part of the cave showing no signs of human occupation.

With one exception, the drawings are executed in a single colour. Three of them were drawn with red ochre, white being the colour used for the remainder.

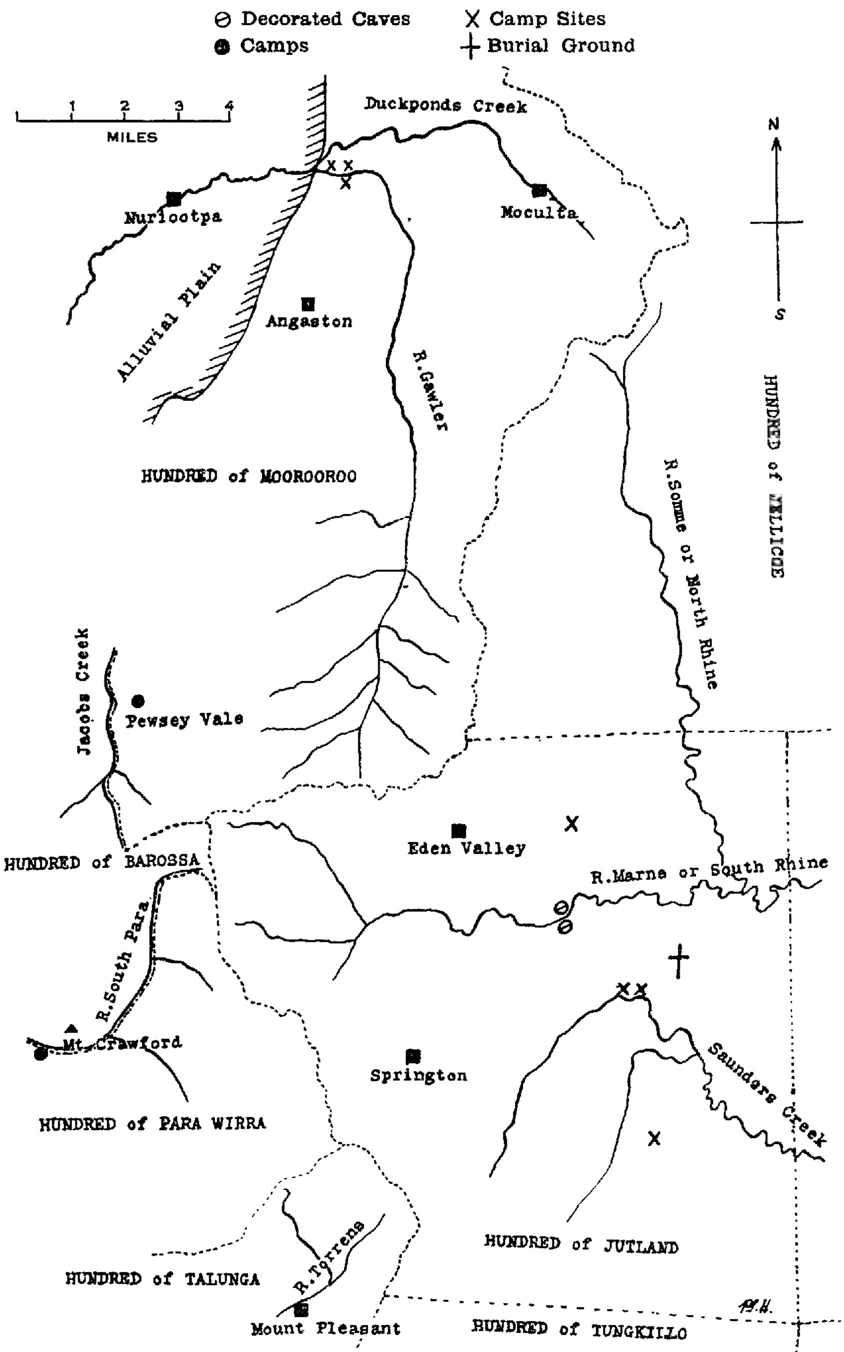

Fig. 1. Map of the district, showing all the occurrences known at present. Those localities, where natives lived within the memory of living people, are noted as camps, while those which can be recognised by the material left behind, are given as camp sites.

Many of the designs appear to represent human beings in various attitudes, several apparently holding a boomerang or a shield (fig. 2, A, B, and C).

The drawings were photographed, but are not shown as distinctly as desired, partly because of the discolouration due to age, and also owing to the mass of names inscribed with variously coloured chalks by numerous visitors.

With the aid of sketches taken in the cave, camera lucida drawings were made from the photographs, and were compared, on a subsequent visit, with the originals, in order to ensure the greatest possible accuracy.

It is curious that, despite the popularity of the locality as a picnic resort, as is shown by the exceedingly numerous inscriptions on the walls of this cave, the existence in it of native drawings was practically unknown. On being asked whether any caves occurred in the district, several local residents directed the writer to Cave A, but no one appeared to think that it contained drawings. The author, however, decided to examine the cave himself, as native remains of this nature have frequently been overlooked or not recognised (1). As a result of subsequent enquiries, Mr. H. Rogers directed the writer to Cave B, informing him that it contained a drawing of what appeared to be a swan.

Although but a few yards distant from Cave B, not even the location of Cave C appears to have been known, as this would assuredly have attracted attention, owing to the numerous designs and colours employed.

Cave B.

This cave faces south, and is situated several hundred yards to the northward of Cave A. It is a rounded opening, measuring approximately 4 feet by 2 feet, in a vertical face of rock near the summit of a ridge north of the river. It widens inside and has a depth of about 8 feet. At the back two drawings, possibly of emus, are scratched on the wall with a soft greyish-coloured stone. The designs terminate at the bottom of the wall.

While the drawings in Cave A are apparently made with white clay or red ochre, applied as a paste with a finger or similar instrument, those in Cave B are scratched with a soft stone, as well as being of a different type to the former. At first this led the writer to doubt the native origin of the Cave B drawings, but the subsequent discovery of a rock shelter (Cave C) a few yards distant, in the eastern face of the same rock, containing many designs drawn with a soft stone, as well as some made by the smearing on of paste, lends probability to their having been executed by the aborigines.

Cave C.

This is a rock shelter, containing numerous drawings on the back wall. It faces east, and is situated near the top of a steep slope. It is semicircular in shape, approximately 12 feet wide in front and 9 feet deep. Seven distinct colours were recognised—black, white, grey, yellowish-brown, orange, dark brown, and dull red. Most of the broad drawings are apparently made by the application of a paste, while the line drawings are executed with a soft stone or charcoal (fig. 3).

A number of designs have partly faded, so that it is impossible to recognise their original shape. A number of others, of a more or less irregular nature, were not reproduced, as doubts existed as to their origin.

This cave appears to be visited but rarely by white people, as it is practically free from the mutilation suffered by Cave A.

As it was found impossible to photograph the drawings, sketches were made as accurately as possible, and measurements of each figure taken in several directions. In order to reduce the size of the plate, spaces between groups of drawings have been slightly compressed in some cases.

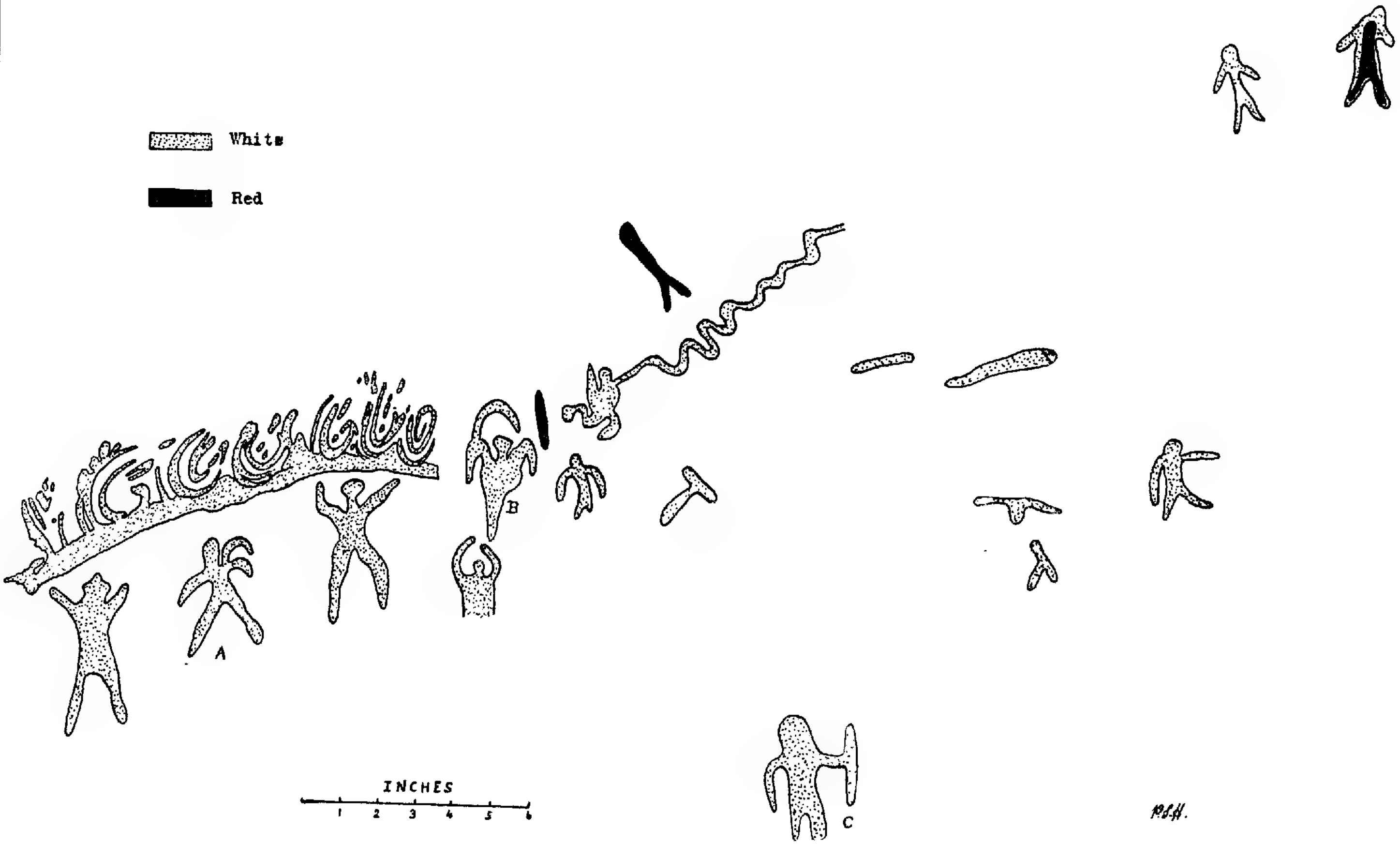

Fig. 2. Native drawings from Cave A, situated on Section 139, Hundred of Jutland, on the south side of the River Marne.

Amongst the designs, a snake, corroboree circle, and the skins of several animals can be recognised. The majority of the drawings appear to be conventional representations of human beings.

2. Camp Sites.

A number of these were discovered by the writer, and yielded a good collection of hammer stones, chippings, and reniform slates.

Several sites exist in close proximity to each other, on both sides of the River Gawler, in Sections 299 and 301, Hundred of Moorooroo. They are windswept, sandy areas, on the top of the low hills flanking the river. Specimens collected here include several slates, one of which is reproduced in fig. 4 A, some hammer stones, a flat stone evidently used as an anvil, a number of fragments of micaceous haematite of variable size, probably used for decorative purposes when powdered, a few chippings, and some chipped blocks of a peculiar type of rock, the nearest outcrops of which occur at a distance of at least nine miles. All of these blocks have a flat base, and are chipped to give the latter a roughly circular shape. The material is comparatively soft, and is composed of thin alternating bands of felspar and actinolite, giving the rock a characteristic striped appearance. The use to which these blocks were put is not known, but from the fact that they were found on every camp site examined in the district, and that they were transported for some distance, indicates their value to the natives.

The most extensive camp sites are situated on Sections 124 and 125, Hundred of Jutland. Here they cover several acres. They occur on the north side of the Saunders Creek, a perennial stream. They occupy a wind-eroded, sandy slope, on the west side of a rough, stony, meridional ridge.

The country to the westward consists of grassy slopes with occasional red gums. At the north-eastern extremity of the site, a small, dense belt of native pines supplies excellent shelter.

Hearths are very numerous. A particularly interesting one occurs near the northern extremity of the site. It is peculiar in that, whereas the others are mere heaps of stones arranged in an irregular manner, this one consists of a ring of stones, the two diameters of the hearth being 7 feet 6 inches and 6 feet 6 inches. The sand inside the ring is blackened, in contrast to the yellowish colour prevailing in the vicinity.

This site yielded the majority of the hammer stones, chips, and slates collected. One of the hammer stones had evidently been used for pounding red ochre, as one half of it was still covered with this material. As in the Gawler River site, specimens of micaceous haematite, probably pounded and used for decoration, and chipped blocks of felspar-actinolite gneiss occurred. Another interesting feature noted was the presence of fire-cracked quartz, the presence of which on camp sites has been described from Olary (2).

Several of the slates collected were sufficiently well preserved to have retained the original markings incised on them by the natives. Some of these are reproduced in figs. 4 B and 4 C. An interesting point is the fact that several slates generally occurred together. In one instance, three were found in contact, projecting from the sand with their longer axes in a vertical direction, and in two other instances four slates were discovered together under the sand. One of the slates which has not been figured, carries incisions probably representing bird-tracks.

In two instances the writer found two and three, respectively, of the slates to occur together. In both these cases, however, fragments of slate were scattered in the immediate vicinity, indicating the former existence of one or more additional slates. In a personal communication, Mr. P. Stapleton, of Henley Beach, states that twenty-eight years ago he also found, near the Patawalonga Creek, four reniform

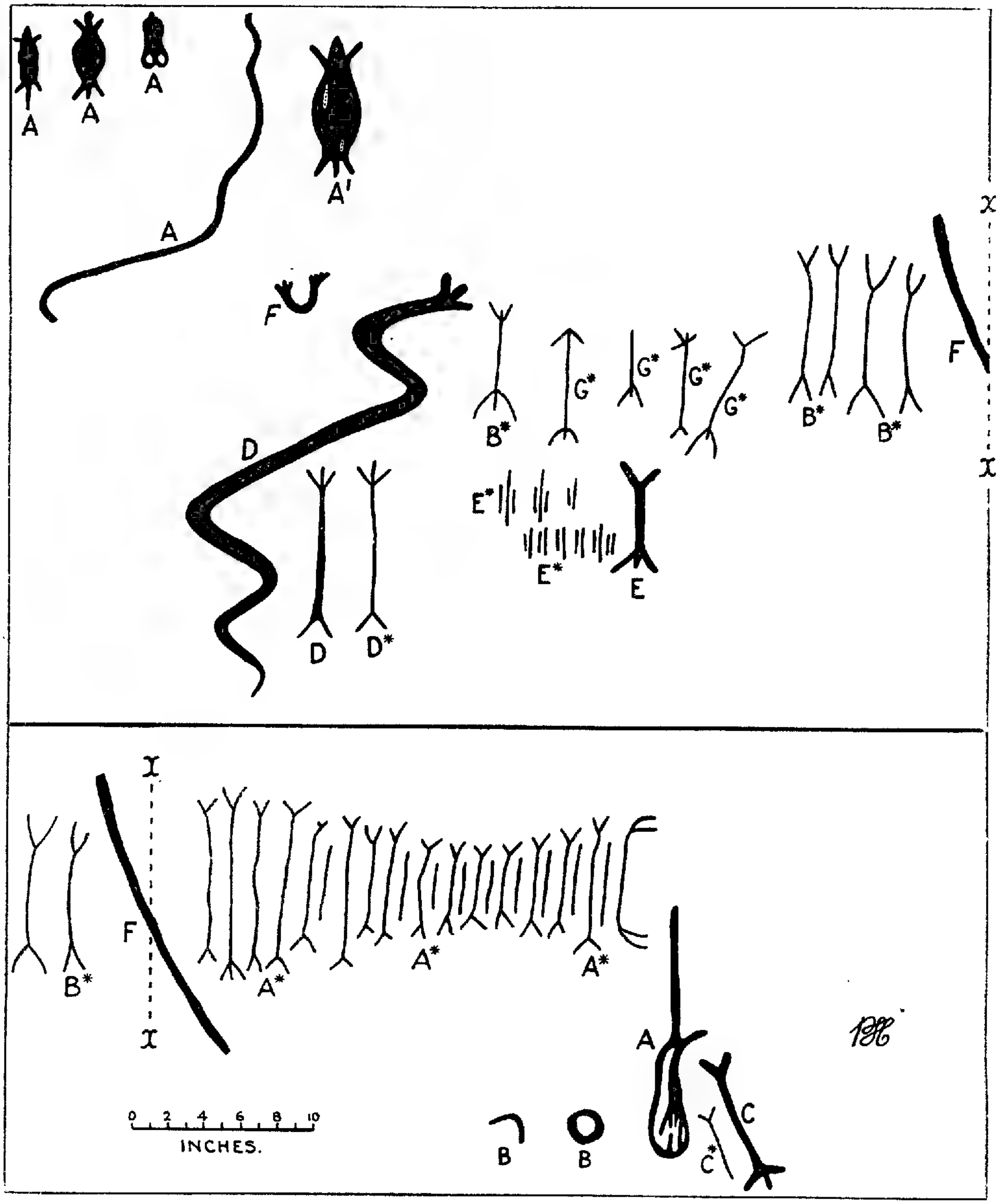

Fig. 3. Sketch of native drawings in Cave C. The seven colours employed are indicated as follows:—A, white; B, yellowish-brown; C, dark brown; D, red; E, black; F, grey; G, orange. An asterisk indicates that the drawings were scratched on the wall with a soft stone or charcoal; the majority of the remainder were executed by the application of a paste. A[1] is drawn in white, with two small areas of a denser white, indicated by stippling; one of these areas may have been intended to represent a pouch. Eight groups, each limited to one colour, can be recognised. They are lettered as follows:—(1) A and A[1], in top left-hand corner of figure; (2) A*; (3) B; (4) B*; (5) C and C*; (6) D and D*; (7) E and E*; (8) G*.

slates lying close together. It seems probable, therefore, that as a general rule, these slates were buried in groups of four.

The prevalent material here, as elsewhere, appears to be a phyllitic slate (3). Instances of the use or attempted use of other material were found.

On the Gawler River site, one specimen was collected, which had been fashioned from a gritty quartzite. It was imperfectly made, as, although it had been shaped correctly, its sides had not been smoothed off, a procedure not so necessary with the slate, which naturally presented a flat cleavage plane, whereas the fracture of the quartzite produced an irregular surface.

On the Jutland camp sites, several well-made objects of this type, but made of mica schist, as well as one made of gritty quartzite, were collected.

The chippings comprise a variety of material, including milky quartz, rock crystal, and quartzite, all obtainable in the district, and some, such as jasper and chalcedony, the appearance of which strongly suggests a Central Australian origin.

Another site, on which but few remains can be seen, is situated on Section 373, Hundred of Jutland. This area is flooded occasionally by a small creek, and little is left beyond a few hearths and hammer stones.

The writer was shown two reniform slates, in an excellent state of preservation, by Messrs. Murray Brothers, who obtained them when the foundations for the house were excavated. This locality is on or near Section 145, and the finding of these slates indicates the former existence at this spot of a native camp site.

3. Burial Grounds.

According to accounts by a number of independent observers, a well-known native burial ground exists on Section 475. At various periods, local residents have unearthed skulls in this and other areas when digging out rabbits.

4. Information obtained from Local Residents.

Through the courtesy of Mrs. I. Grigg, of Springton, the writer was enabled to obtain some interesting information concerning the natives of the district. Mrs. Grigg is over 80 years of age and lived on Pewsey Vale Station as a girl. The notes obtained from her, together with a few additional details supplied by others, are given below:—

A number of natives camped near the Pewsey Vale Head Station, on Jacob's Creek.

Another camp was situated on the South Para River, to the south-west of Mount Crawford, the native name for which hill was Teetáka. The number of natives in this camp is said to have, at times, reached 600.

Both of these camps were more or less permanent, but parts of the tribe wandered over the country at various times, ultimately returning to the main camp.

The natives are believed to have disappeared over 70 years ago.

Frequently they wore no clothing whatever; when any was worn, it consisted of a bilby—or an opossum—skin rug, which was folded once and held up by a string tied around the waist. The skins were prepared for use by drying them, and subsequently cutting two sets of closely spaced parallel straight lines in the inner skin. The two sets of lines were at an acute angle to each other, the resulting diamond pattern making the skin flexible.

After the age of puberty, the men occasionally wore reeds, several inches in length, inserted into the septum of the nose.

For corroborees they greased their hair and painted themselves with white and red colours. They tied leaves and feathers around the waist, and bound them around the head.

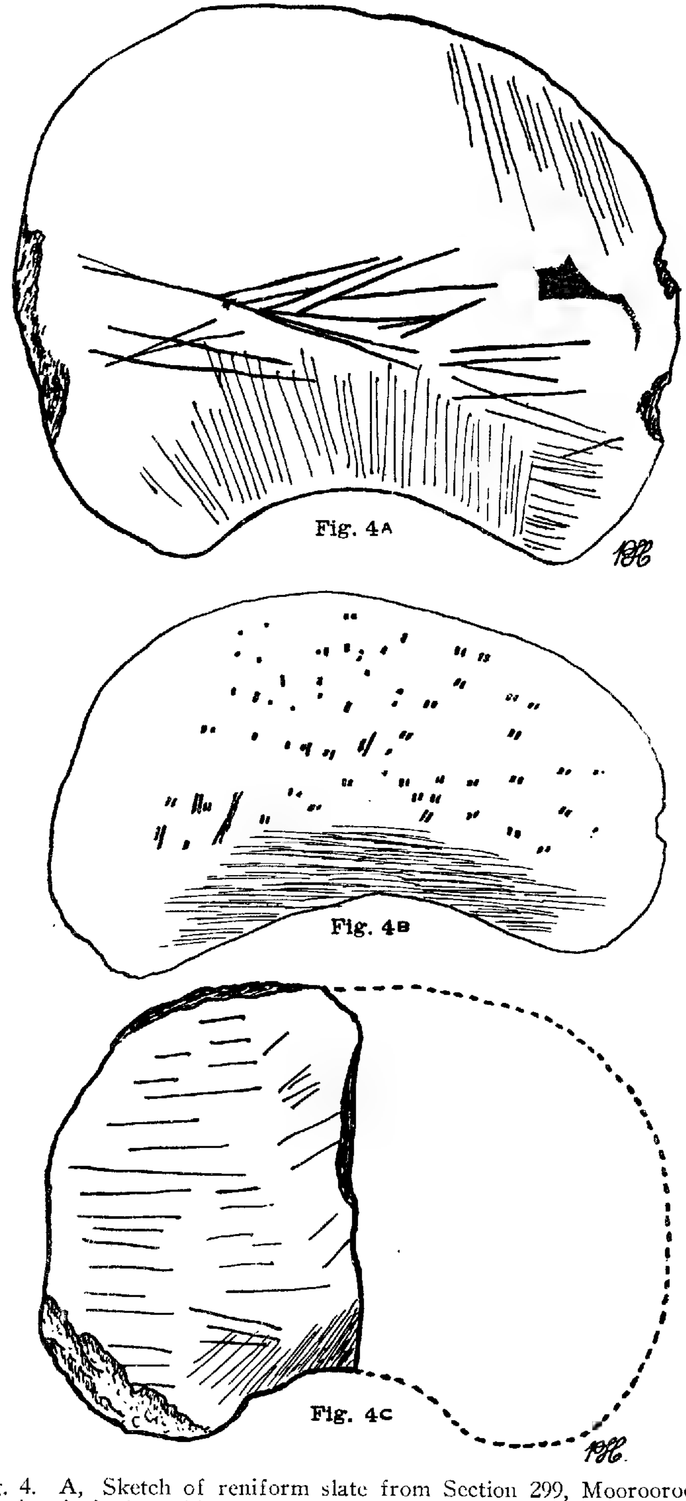

Fig. 4. A, Sketch of reniform slate from Section 299, Moorooroo, showing incised markings. B and C, Sketches of slates from Section 124, Jutland, showing decoration and scratches due to sharpening of the concave edge. (Three-fourths natural size.)

The older men bore incisions on the shoulders and arms. These cuts were roughly parallel and consisted of 3 rows on the back and 3 on the arms. The incisions were made with glass or bone.

One full-blood deaf and dumb native was known. He was always kept painted red all over by the natives. They used, for this purpose, a mixture of ochre and fat.

The wurleys were constructed by placing three sticks in the ground in a triangular position. Big sheets of bark (red gums) were cut off to the wood, and laid against the sticks. Grass trees and rushes were cut to supply the material for the roof.

The women carried their babies in nets on their backs. Nets were used also for catching kangaroos, wallabies, etc. These nets were about 5 feet high and 100 feet long. They were held in a semicircle, and the game driven into them.

The string was made of certain kinds of grass. For the manufacture of the nets the natives used a stick, and made a loop, which they hitched over a toe.

They climbed trees by cutting steps, but used iron spikes after the occupation of the country by Europeans made them obtainable.

Weapons.—Some of their spears were merely sharpened pieces of wood. Others had barbs for a distance of 8 inches from the tip. The barbs were set in zig-zag fashion, and consisted of the teeth of animals. Sometimes they threw their spears without throwing-sticks, at other times with them; the throwing-sticks were about 2 feet long. The waddies had handles about 2 feet in length and a knob at one end, which sometimes was the size of a man's fist, but this feature was very variable.

Cooking was done by scooping a hollow in the hot ashes, covering the food with ashes and hot coals, and generally removing it before it was completely cooked. The ashes were knocked off, and the animal cut open with a sharp stone. Sometimes the food before being covered over was placed on a layer of hot stones.

A fleshy root, commonly referred to as 'yam,' formed part of their food supply.(1)

At corroborees, the women rolled opossum skins tightly together, placed them in a heap, and hit them with sticks. They are believed to have varied the sounds produced by the degree of tightness with which the skin was rolled.

The natives had good teeth, only one old man being known to have possessed faulty ones. None of them had any of their teeth removed. This is in accord with the statements made by Dr. Campbell (4).

The women washed their babies with ashes and water.

The natives had one fire only, and that just in front of the opening of the wurley. They slept with their feet towards the fire. During cold weather the wurleys and fires were nearer each other.

Only one instance of the death and burial of a native was observed. This was a native girl, who died at the Mount Crawford camp. She was wrapped up and placed on two long poles, across which other sticks had been placed. She was carried to the burial ground east of Eden Valley, referred to above. The natives howled for one night, then set off early in the morning to the burial ground, howling the whole of the way. At intervals more howling natives would appear, following the procession.

This paper would be incomplete without a reference to the very numerous burnt-out, hollow red gums occurring in the district. The majority of the openings face east or north, and provide excellent shelter. Whether they were used as such by the natives, and to what extent they were responsible for these hollowed-out trees, should be the subject of further enquiries.

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(1) Miss E. Macklin, B.Sc., informs me that the plant referred to probably is *Microseris Forsteri*, Hook.

From the accounts of residents it appears that after the extinction of the local natives, aborigines from the River Murray paid periodical visits to this district. They are said to have cut bark canoes in this area, carrying them back to the River Murray. For this purpose they selected those red gums possessing especially thick bark. When arriving from the Murray, they carried with them bundles of mallee sticks, which they converted into spears while staying in the Eden Valley district. The main attraction, however, appears to have been the numerous opossums, the skins of which, according to the natives, were superior to those from any other locality.

The last of the River Murray blacks disappeared from this region about fifty years ago.

According to Messrs. Teichelmann & Schürmann, the name "Marimeyunna" was applied to a north-eastern tribe of natives. This very probably included those in the Eden Valley district. Mari=east, meyu=man. The natives in the vicinity of Lyndoch appear to have been referred to as the "Wirra Tribe," or Wirra meyu=bushman.

5. Native Place Names.

Since no record of the language spoken by the extinct natives could be obtained, an attempt has been made to discover the meaning of any native place names in the district, and to determine by this means whether the language of these natives was related to that of the Adelaide or the Narrinyeri tribe, vocabularies of both of which exist.

In order to guard as much as possible against imported names, the earliest record of their use has been determined, when obtainable.

It will be seen that all of such native words as are incorporated in the place names and which have been traced, form part of the vocabulary of the Adelaide tribe (5).

A large part of the following notes was supplied in a personal communication by Mr. Rodney Cockburn, who also assisted the writer by indicating other sources of information.

A list of the names selected, together with the information obtained concerning them, is given below:—

Cowie-aurita: The native name for Jacob's Creek, meaning "yellowish-brown water" (6).

Cudlee Creek: First settled in 1838. Evolved from "kadli," meaning "dog." Wild dogs were very numerous there in the pioneer days (7).

Gumeracha: Known in 1839 as "Umeracha." Was applied by the natives to a fine waterhole in the River Torrens (7).

Moculta: The native name for a hill near the township. It is now known as "Parrot Hill" (8).

Moorooroo: Surveyed in 1842. Means "meeting of the waters." It is a settlement situated near the junction of the Jacob's Creek and the North Para or Gawler River (6) and (7).

Mudla Wirra: Gazetted in 1847. Mudla=nose; Wirra=tree (5).

Para Wirra: Known in 1846. Parri=river; Wirra=tree. It means a "river lined with trees." In this connection it is interesting to note that the native name for the River Sturt is given as "Warri Parri," and that part of the River Torrens flowing through Adelaide was known as "Karra Wirra Parri," meaning "river of the red gum forest" (5) and (8).

Poonawatta: A native name supplied to the writer by Mr. Thyer, of Eden Valley. It was applied by the natives to a locality a few miles to the north-west of the township.

Towitta: Named in 1876. Was the native name of a permanent spring near the township. It may be derived from "witto-witto," meaning "reeds" (9). The native name for the River Torrens near the Reedbeds was "Wito-ingga" (8).

Teetaka: The native name for Mount Crawford, supplied to the writer by Mrs. I. Grigg, of Springton.

Yatala: Sometimes spelt "Yertala." It means "inundated." It was applied by the natives of the Weera tribe to the locality north of the River Torrens, from Port Adelaide to Teatree Gully (10) and (6). In the S. Austr. Gazette and Col. Register, May 25, 1839, an account is given of a dinner to the aborigines of the Adelaide and Weree tribes, the latter probably being identical with the Weera tribe referred to above.

It is interesting to note that the native name for the River Torrens when in flood was "Yertala" (8).

Summary.

A number of native remains hitherto undescribed have been recorded. They occur in a closely settled district about 40 miles north-east of Adelaide. It is extremely unlikely that in the large area comprising the Mount Lofty Ranges these and the drawings described from the South Para near Gawler (11) should be the only remains of native occupation extant. A systematic search for further occurrences would probably be amply repaid.

In conclusion, the writer voices his regret that these important records of the former native occupation should be doomed to rapid disappearance, owing to the mutilation which they are subjected to by visitors ignorant of their value.

Acknowledgments.

The writer desires to express his appreciation of the assistance and advice of the following:—Mrs. I. Grigg, Springton; Messrs. Bayes and Rogers, Eden Valley; Mr. Rodney Cockburn; the Officials of the Lands and Survey Department; and the Officers of the Archives Department.

References.

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(3) Trans. Roy. Soc. S. Austr., vol. xlviii., p. 74.
(4) Dentition and Palate of the Australian Aboriginal. By T. D. Campbell, D.D.Sc., pp. 85-90.
(5) Outlines of a Grammar, Vocabulary, and Phraseology of the Aboriginal Language of South Australia. By C. G. Teichelmann and C. W. Schürmann. 1840.
(6) Old Records of the Department of Lands and Survey, South Australia.
(7) Personal communication from Mr. Cockburn.
(8) Nomenclature of South Australia. By Rodney Cockburn.
(9) The Australian Race, vol. ii. By E. M. Curr.
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AUSTRALIAN HYMENOPTERA PROCTOTRYPOIDEA.—No. 5.

By Alan P. Dodd.

[Read October 14, 1926.]

This paper deals mainly with the family Scelionidae, and includes a revision of the genera *Mallateleia,* Dodd, *Neuroscelio,* Dodd, and *Mirotelenomus,* Dodd; several species are added to the first-named, and one new species to the last-named. New species are added in the genera *Apegus,* Foerster, and *Acolus,* Foerster, and a new genus is proposed in this family. In the Belytidae one new genus and two new species are described, and in Diapriidae one new species is included.

The author is indebted to the South Australian Museum for the loan of types for re-examination; five new species are described from material received for identification from that institution.

Family BELYTIDAE.

Neobetyla spinosa, n. sp.

♀. Length, 2·65 mm. Head, antennae, and the legs bright orange-yellow; thorax reddish-brown, darker on the metathorax and the sides; petiole of abdomen very deep brown; body of abdomen dusky-brown at base, bright orange for its posterior two-thirds, and with a faint dusky cross-stripe just beyond the middle; eyes black.

Head globular, smooth and shining, with scattered very long hairs; eyes small, not so long as their distance from the posterior margin; ocelli minute; antennal prominence very large and conspicuous. Antennae 15-jointed; scape long and slender; pedicel about twice as long as its greatest width; funicle joints a little narrower than the pedicel, 1 as long as the pedicel and over twice as long as wide, 2 distinctly shorter than 1, 6 as wide as long; club 7-jointed, the joints (except the last) distinctly wider than long, the first not as wide as the others. Thorax slender, narrower than the head, three times as long as its greatest width; smooth and shining, and with scattered long hairs; pronotum densely pubescent anteriorly; scutum longer than its greatest width, much narrowed in front, strongly depressed, the parapsidal furrows distinct; scutellum longer than wide, with a strong basal fovea; postscutellum with a median carina, and carinated margins; propodeum wider than long, with light pubescence, with a strong median carina, its posterior margin deeply concave, carinate, and terminating laterally in acute spined angles. Wings absent. Petiole of abdomen almost twice as long as wide, a little swollen in centre, laterally with fine pubescence and a few long hairs, its dorsal surface smooth and bordered by a light carina on either side; body of abdomen twice as long as its greatest width, much wider than the thorax; depressed at base, the depression margined by obscure carinae; surface smooth, with scattered long bristles; composed of four segments, of which 2 (first body segment) occupies most of the surface, 3 and 4 short and transverse, 5 conical and as long as its basal width.

South Queensland: Blackall Range, one female taken in March by H. Hacker. Type, in the Queensland Museum.

The genus *Neobetyla,* Dodd, formerly contained two species, *N. pulchricornis,* Dodd, and *aurea,* Dodd, from North Queensland. *Spinosa* at once differs in the spined posterior angles of the propodeum, which is more lightly pubescent than in the other two; the antennae, too, are uniform in colour in this species. The

parapsidal furrows appear to be truly absent in *aurea,* faint in *pulchricornis,* and rather distinct in *spinosa.*

Acanthobetyla, n. gen.

♀. Head normal for the family; subglobular, the eyes small, the frontal prominence very large and conspicuous; ocelli absent; in the centre of the vertex between the eyes is a pair of erect short teeth. Antennae normal, 15-jointed, the scape slender, the club 5- or 6-jointed. Thorax strongly narrowed, its sides subparallel; pronotum long, armed on either side in front with a sharp erect tooth; scutum narrow, longer than wide, strongly depressed, the parapsidal furrows absent; scutellum long, narrow, almost as long as the scutum, strongly depressed, its lateral margins raised and carinate; postscutellum short, depressed, its lateral margins raised and carinate; propodeum rather long, armed laterally with dense stiff comb-like setae. Forewings reaching apex of abdomen; broad; without marginal and discal cilia, and quite without venation; not limpid but yellow, opaque, and parchment-like; with a transverse fold or impression before one-half its length, and two longitudinal impressions in the distal portion; distal margin concave. Hindwings linear, bristle-like, reaching to the apex of the petiole. Petiole of abdomen somewhat longer than wide, somewhat humped, its sides with stiff setae; body of abdomen of four visible segments, of which the basal segment occupies most of the surface; three times as wide as the thorax, and twice as wide as the head; less than twice as long as its greatest width; sharply incised at base to receive the petiole.

Type, *A. mirabilis,* described herewith.

A very peculiar genus on account of its unique wings, of which it is rather difficult to give an adequate description. The narrowed thorax with its reduced depressed sclerites is typical of wingless genera such as *Betyla,* Cameron, and *Neobetyla,* Dodd.

Acanthobetyla mirabilis, n. sp.

♀. Length, 2·40 mm. Wholly bright ferrugineous, including the legs and antennae.

Body smooth, without sculpture. Antennal scape as long as the next six joints combined; pedicel one-half longer than its greatest width; funicle joints smaller and a little narrower than the pedicel, all somewhat longer than wide, 1 a little the longest; apical five or six joints gradually widening to form an ill-defined club, of which the three penultimate joints are plainly wider than long, the apical joint conical and longer than wide.

North Queensland: Cairns district, one female taken among fallen leaves. A. M. Lea. Type, in the South Australian Museum.

Family DIAPRIIDAE.

Propentapria pulchella, n. sp.

♀. Length, 2·40 mm. Black, the abdomen washed with red at apex; coxae dusky-brown, the legs bright red, the apical portion of the femora and tibiae somewhat dusky; antennal scape fuscous, red at base, the pedicel dusky, the next seven joints bright red, the four apical joints black.

Head normal, subglobular; from dorsal aspect twice as wide as long; eyes small, from dorsal aspect not as long as their distance from the posterior margin; surface smooth and shining, with a few scattered small punctures giving off very long fine hairs. Antennae rather shortly pubescent; scape long and slender, somewhat curved; pedicel twice as long as its greatest width; funicle 1 a little narrower and no longer than the pedicel, 2-6 gradually shortening, 6 somewhat longer than wide; club ill-defined, 4- or 5-jointed, gradually widening to the penultimate, the joints as wide as long, the apical joint twice as long as the preceding. Thorax shining,

smooth, with scattered long hairs; pronotum very short medially, long laterally; scutum not as long as its greatest width, its anterior margin strongly convex, the parapsidal furrows rather delicate but complete; parapsides feebly depressed and with a foveate groove along the outer margin; scutellum longer than wide, the basal fovea much wider than long, subdivided by three carinae into four foveae; lateral margins of scutellum with an obscure groove; propodeum long, at base with a short raised tooth, its dorsal surface smooth with a pair of median carinae which join at base; propleurae with a foveate line near the posterior margin; mesopleurae quadrate, with a delicate groove against the dorsal margin; metapleurae with dense white pubescence, smooth at base, coarsely rugose-punctate for the rest. Forewings reaching a little beyond apex of abdomen; broad; subhyaline, with three brown bands as follows: a narrow band at the basal vein, a broad band suspended from the marginal and stigmal veins, and a broad less definite band toward the apex; venation dark; marginal vein linear, one-fifth as long as the submarginal, several times as long as the short stigmal vein. Petiole of abdomen $2\frac{1}{2}$ times as long as wide, with four dorsal carinae, the sides shortly pubescent and with a few long setae; body of abdomen slender, depressed at base, pointed at apex, the oviposital valves protruding for some distance; segment 2 (first body segment) over twice as long as 3-6 combined; 3 and 4 very short and transverse; 5 rather long; 6 one-half as long as 5; 5 and 6 with a row of long hairs at apex, 5 with a few long hairs at base.

South Australia: Mount Lofty, one female, A. M. Lea. Type, in the South Australian Museum.

I have recently (Linn. Soc. N.S. Wales, 1926) discussed the genus *Propentapria*, Dodd. The species described above differs from the three previously known species in the fasciate wings, and in the basal fovea on the scutellum being 4-foveate instead of 5-foveate.

Family SCELIONIDAE.

Nyleta, n. gen.

♂, ♀. Head, from dorsal aspect, no wider than the thorax, much wider than long, its posterior margin straight; from lateral aspect, the frons is lightly convex, the vertex sharply declivous from a little behind the lateral ocelli; from frontal aspect, wider than deep; frons not or hardly depressed above the antennal insertion, with a median carina running from the frontal ocellus, and dividing in the centre of the frons into two branches, which run to either antennal insertion; eyes large, bare; ocelli large, close together and separated from the eye margins by their own diameter; mandibles tridentate. Antennae 12-jointed in both sexes; bulba long, the scape slender; in the male, the flagellum filiform, the joints long and slender; in the female, with a 6-jointed club, the first two funicle joints very long. Thorax stout, from dorsal aspect slightly longer than its greatest width, from lateral aspect slightly longer than high, convex above; pronotum not visible from above, except as a thin line laterally; scutum stout, convex, its anterior margin truncate, the latero-anterior margins very oblique; parapsidal furrows absent; scutellum large, semicircular, with foveate anterior and posterior margins; postscutellum short, transverse but rather prominent, its posterior margin concave; propodeum declivous, short, its lateral margin carinate, its lateral angles prominent, its posterior margin straight and carinate for some distance, this carina joining a fainter carina which runs obliquely outwardly from the base, the meson depressed and in the female hidden by the abdominal prominence, no true lateral carinae are present; spiracles unusually large and prominent, situated in the anterior angles of the propodeum; mesopleurae large and broad, the depression rather small, the area below and in front of the depression rather well developed; metapleurae much smaller than the mesopleurae. Forewings extending

beyond apex of abdomen; broad; normal; submarginal vein joining the costa at fully one-half the wing length, the marginal vein a little shorter than the long stigmal vein which is a little convexly curved, the postmarginal three times as long as the stigmal; basal and median veins faintly marked. Legs slender, the last two pairs long; meso- and metacoxae close together and widely separated from the anterior pair. Abdomen regularly fusiform, the apex pointed in the female, blunt in the male; somewhat longer than the head and thorax united; segments 2 and 3 longest, 2 a little longer than 3, each a little shorter than its greatest width; basal segment in female with a short blunt prominence at base.

Type, *N. striaticeps*, described herewith.

This genus is erected to contain a species which is not congeneric with any known Australian form, and which I am unable to place in a satisfactory manner. It has no very striking features; the distinguishing characters are the truncate anterior margin of the scutum, the large spiracles of the propodeum, the large ocelli situated close together, and the median carina of the frons. In some respects it resembles *Hoploteleia*, Ashmead, but that genus has a deep margined frontal depression, and the parapsidal furrows are complete. The abdomen is more regularly fusiform than in any of the Australian species of *Baryconus*, Foerster.

Nyleta striaticeps, n. sp.

♀. Length, 2·90 mm. Black; legs, including the coxae, bright golden-yellow, the tarsi dusky; antennal scape and pedicel clear yellow, the first two funicle joints suffused with yellow, the remaining joints black.

Frons on either side with several strong striae that extend from the mouth to the lateral ocelli; surface on either side of the median carina irregularly rugose above, smooth below; between the ocelli the surface is rugose; behind the ocelli are strong transverse striae, between which are dense shallow punctures bearing a conspicuous pubescence of long fine hairs; frons without pubescence; cheeks rather densely punctate and with light pubescence, striate toward the mouth. Antennal scape long and slender; pedicel more than twice as long as its greatest width; funicle 1 more slender and twice as long as the pedicel; 2 two-thirds as long as 1; 3 one-half as long as 2; 4 somewhat longer than wide; club slender, the joints as long or a little longer than wide. Scutum and scutellum densely sub-confluently punctate, the punctures moderately small, and with a pubescence of fine hairs; mesopleurae punctate, the depression smooth centrally, foveate-striate along its margins; metapleurae with a median carina, smooth above the carina, striate below the carina, punctate against the coxae. Forewings lightly stained; venation deep yellow. Segment 1 of abdomen striate, its prominence smooth; 2 at base with strong striae which gradually fail posteriorly, laterally without striae but with numerous small punctures, and there are scattered punctures on the posterior half dorsally; 3-6 with numerous moderately dense punctures, which become smaller apically; all punctures bearing fine setae.

♂. Frons narrowly smooth on either side of the forks of the median carina, laterad of this smooth area with several strong longitudinal striae which curve and join the median carina above the forks; punctures of scutum confluent; striae absent on the metapleurae. Antennal scape clear yellow, the pedicel dusky-yellow, the flagellum black; pedicel fully twice as long as its greatest width; flagellar joints shortly densely pubescent; 1 twice as long as the pedicel, 2-9 gradually decreasing in length, 9 one-half as long as 1, 3 slightly excised on one side towards base.

South Queensland: Mount Tambourine, 2,000 feet, one female, three males, in January and April, A. P. Dodd. Type and allotype, in the Queensland Museum. Paratypes, in the South Australian Museum and the author's collection.

Neuroscelio, Dodd.

Archiv fur Naturgeschichte, Berlin, 79, Sept., 1913, p. 170.

♀. Head normal; from dorsal aspect much wider than long; eyes moderately small, bare; ocelli close together in the centre of the frons and far from the eye margins; mandibles near the base on the outer side with a blunt tooth or tubercle, bidentate, the teeth acute. Antennae 12-jointed; scape normal; funicle joints not long; club stout, compact, truly 7-jointed. Thorax, from dorsal aspect, somewhat longer than its greatest width; pronotum very narrowly visible from above; scutum stout, its anterior margin broadly rounded, the parapsidal furrows complete; scutellum with anterior and posterior rows of foveae, its posterior margin almost straight; postscutellum transverse, rugose, not prominent medially; propodeum moderately short, rugose, with a median carina that is raised at base in the form of a tubercle. Forewings rather short, not extending beyond apex of abdomen; stigmal vein long, twice as long as the marginal, the postmarginal hardly developed; basal and median veins represented by thick brown lines, the radial vein represented by a lighter brown line and forming a false closed radial cell. Abdomen broadly oval, narrowed at base, rounded posteriorly; less than one-half longer than its greatest width; segments 1 and 2 longest, 2 somewhat longer than 1 and longer than 3-6 united; 3-6 each short and transverse.

Type, *N. nervalis*, Dodd, by designation.

The striking features of this genus are the long second abdominal segment and very short third segment; this latter character occurs in *Telenomus*, Haliday, and its allies. But *Neuroscelio* is not related to *Telenomus* or to *Hadronotus*, Foerster, the abdomen being much more narrowed at its base. In general appearance the type species suggests a relationship with *Anteris*, Foerster. The truly 7-jointed antennal club is unusual, while the false venation is strongly developed. One species only is known.

Neuroscelio nervalis, Dodd.

Loc. cit., p. 170.

♀. Length, 1·30 mm. Black, the abdomen deep brown; legs, including the coxae, golden-yellow, also the first five antennal joints.

Antennal scape as long as the next six joints united; pedicel twice as long as its greatest width; funicle 1 a little shorter and narrower than the pedicel, almost twice as long as its greatest width, 2 as wide as long, 3 wider than long; club joints very transverse. Scutum and scutellum with impressed scaly reticulation; parapsidal furrows widening posteriorly. Forewings lightly cloudy, almost hyaline at base; venation fuscous. Segment 1 of abdomen longitudinally striate, the remaining segments smooth and shining.

North Queensland: Cairns district, one female in May, A. A. Girault. Type, in the South Australian Museum.

Apegus, Foerster.

Up to the present, this European genus has not been recognised as occurring in Australia. However, *Microteleia pulchricorpus*, Dodd, should be transferred here, and a second species is described below. The genus is characterised, *inter alia*, by the antennae of the female having no well-defined club.

Apegus pulchricorpus, Dodd.

Microteleia pulchricorpus, Dodd, Trans. Roy. Soc. S. Austr., vol. xxxix., 1915, p. 449.

Apegus squamosus, n. sp.

♀. Length, 1·20 mm. Black; legs golden-yellow, the coxae fuscous; antennal scape yellow, the remaining joints fuscous somewhat suffused with yellow.

Head, from dorsal aspect, transverse, the vertex rather thin, the posterior margin gently concave; from lateral aspect the head is situated somewhat below the anterior portion of the thorax, the vertex shortly declivous posteriorly; from frontal aspect wider than deep; frons not depressed above the antennae, but with a short blunt median carina; eyes moderately small, very wide apart, faintly pubescent; ocelli in a curved line, the lateral pair somewhat closer to the eyes than to the median ocellus; vertex and frons with open impressed reticulation, the frons broadly smooth in the centre and with a few minute punctures, against the mouth with fine dense striae. Antennal scape long and slender, as long as the next four joints combined; pedicel slender, three times as long as its greatest width; funicle 1 a little shorter than the pedicel, 2-4 gradually shortening, 4 somewhat longer than wide; club hardly differentiated, the joints slightly wider than the funicle and distinctly, although not greatly, longer than wide. Thorax from lateral aspect, distinctly flattened, situated somewhat obliquely to the head and abdomen, the metathorax projecting below the base of the abdomen, the scutum anteriorly strongly convex, the meso- and metapleurae long and narrow; from dorsal aspect, the thorax is flat and scarcely longer than its greatest width; pronotum situated below the anterior margin of the scutum and not visible from above; scutum stout, flat for most of its surface but strongly convex anteriorly, the anterior margin very broadly rounded, with fine impressed reticulation anteriorly, broadly smooth on the median lobe posteriorly; parapsidal furrows very wide apart, parallel, failing anteriorly; scutellum short, transverse, its posterior margin straight, its surface smooth, the anterior and posterior margins with punctate rows; postscutellum very short and transverse, without a median plate, at base with a line of punctures; propodeum very short at meson, longer laterally, unarmed, finely reticulate at base medially, with very fine lateral carinae, almost smooth laterally; mesopleurae smooth; metapleurae reticulate. Legs slender, the femora unusually so. Forewings reaching apex of abdomen; broadly rounded at apex; hyaline, with a broad light-brown transverse band involving the stigmal and portion of the marginal and postmarginal veins; discal cilia fine and rather sparse, absent; venation pallid; marginal vein twice as long as the stigmal, which is rather short, the postmarginal somewhat longer than the marginal. Abdomen fusiform; somewhat narrowed at base; no longer than the head and thorax united; twice as long as its greatest width; segment 1 short, transverse; 2 almost twice as long as 1; 3 the longest, a little longer than 2, twice as wide as long; 4 slightly more than one-half as long as 3, transverse; 5 shorter than 4; 6 very small; 2 at base transversely depressed as in the genus *Scelio*, Latreille; 1 finely densely striate; 2 with a few fine striae at base; 2-5 with open impressed reticulation; 2 and 3 broadly smooth laterally, 4 and 5 more narrowly smooth; a very few fine short hairs are present along the lateral margins.

South Queensland: Brisbane, one female, A. P. Dodd. Type, in the Queensland Museum.

Pulchricorpus and *squamosus* are certainly congeneric, but are abundantly distinct, and can be separated by means of the following characters:—

Head, thorax, and base of abdomen, orange-yellow; abdomen black; antennae varicolored, joints 2 and 3 and 8-12 black, 4-7 pale yellowish-white; forewings with two bands	*pulchricorpus*
Body wholly black; antennae not varicolored, joints 2-12 dusky-yellow; forewings with one band	*squamosus*

MALLATELEIA, Dodd.

Trans. Roy. Soc. S. Austr., vol. xxxvii., 1913, p. 151.
Mallateleioides, Dodd, *ibidem*, p. 152.

♀, ♂. Head, from dorsal aspect, transverse; from lateral aspect, the frons lightly convex, the vertex sloping sharply to the occiput; from frontal aspect,

subcircular, wider than deep; lower frons rarely noticeably depressed, the depression not margined; eyes moderately large, bare; mandibles tridentate, the outer teeth long and acute, the inner tooth small; maxillary palpi 4-jointed. Antennae 12-jointed in both sexes; in the female the funicle joints short, shorter than the pedicel, the club compact and 6-jointed; in the male the flagellum moniliform, shortly pilose, the joints not much longer than wide, 2 a little shorter than 1 or 3. Thorax rather stout, not much longer than its greatest width; pronotum visible for its entire width; scutum wider than long, the parapsidal furrows usually well marked, absent in one species; scutellum transverse, its posterior margin straight, with anterior and posterior rows of foveae; postscutellum unarmed, transverse, usually rather prominent, its posterior margin straight; propodeum sloping laterally, depressed at meson and margined on either side with a straight carina. Femora normal, or considerably swollen. Forewings not reaching beyond apex of abdomen, the margins almost equally inclined, the discal cilia exceedingly dense; without true veins, but with darker lines of fumation representing submarginal, a short thick marginal or stigmal, basal and median veins. Abdomen pyriform, broad, much narrowed at base, the apex shortly pointed in the female, blunt in the male; segments all wider than long, 3 the longest and as long as 1 and 2 or 4-6 united.

Type, *Mallateleia giraulti*, Dodd.

A curious genus on account of the non-development of the venation. Its nearest ally in Australia is probably *Anteris*, Foerster, which possesses well-developed submarginal, marginal and stigmal veins; the short funicle joints and compact club in the female recall *Anteris;* the abdomen is of much the same type, but is shorter in *Anteris;* the scutellum in *Anteris* is not straight posteriorly, and the postscutellum bears a distinct tooth.

Mallateleioides, Dodd, is a true synonym, the genotype possessing the false venation in a more marked degree than in *M. giraulti*. The genus is a natural one, and is apparently well represented in Australia, the present paper recognising eleven species, of which seven are described as new.

Key to the Species of *Mallateleia*, Dodd.

1.	Males	9
	Females	2
2.	Parapsidal furrows absent, the scutum with large confluent punctures; a black species	*kiefferi*, Dodd
	Parapsidal furrows distinct and complete; punctures of scutum smaller and not confluent	3
3.	Body wholly black, rarely touched with red on sides of thorax ..	4
	At least the thorax partly reddish or yellowish	8
4.	Head with a dense rugose sculpture; posterior half of median lobe of scutum with longitudinal grooves	*rugosiceps*, n. sp.
	Head punctate or finely reticulate; median lobe of scutum without grooves	5
5.	Lower frons with conspicuous white pubescence; scutum without stiff white hairs	6
	Lower frons without conspicuous white pubescence; scutum with stiff white hairs	7
6.	Forewings with a hyaline spot near anterior margin at less than one-half its length, and the base is hyaline; segments 3-5 of abdomen with dense fine reticulation	*maculipennis*, n. sp.
	Forewings uniformly clouded; segments 3-5 with rather dense punctures	*pilosifrons*, n. sp.
7.	Head with scattered punctures and dense fine reticulation; segments 4 and 5 of abdomen with fine reticulation	*pilosiscutum*, n. sp.
	Head without reticulation; segments 4 and 5 of abdomen smooth ..	*punctatifrons*, n. sp.
8.	Segment 3 of abdomen rather densely punctate laterally, 4 with numerous punctures	*collaris*, n. sp.
	Segment 3 with a very few fine punctures far laterally, 4 with a row of fine punctures near anterior and posterior margins ..	*giraulti*, Dodd

9.	Head, thorax, and abdomen black	10
	At least the thorax wholly or in part reddish	11
10.	Segments 4 and 5 with fine reticulation	*westwoodi*, Dodd
	Segments 4 and 5 with fine punctures	*pilosifrons*, n. sp.
11.	Femora much swollen; flagellar joints 3-9 very short and transverse	*crassipes*, n. sp.
	Femora not swollen; flagellar joints as long as wide	12
12.	Segment 2 of abdomen densely striate; punctures of head dense and subconfluent	*splendida*, Dodd
	Segment 2 smooth; punctures of head scattered	13
13.	Head, scutum, and scutellum dark; venation apparent	*giraulti*, var. *foersteri*, Dodd
	Head, scutum, and scutellum clear red; venation not showing ..	*giraulti*, Dodd

MALLATELEIA KIEFFERI, Dodd.

Arkiv fur Naturgeschichte, Berlin, 79, 1913, p. 177.

♀. Length, 2·75 mm. Black, the propleurae washed with red; coxae black, the legs reddish-yellow, the femora dusky; antennal scape dusky, the next five joints testaceous, the club black; mandibles red.

Head normal, the vertex sloping gently to the occiput; vertex, upper frons, and cheeks with large rather dense punctures each bearing a long fine hair; lower half of face hardly depressed, impunctate, except for a few scattered punctures laterally; mandibles very long, almost as long as the scape, tridentate, the middle tooth small; maxillary palpi long, 4-jointed. Antennal scape long and slender; pedicel twice as long as its greatest width; funicle joints somewhat narrower than the pedicel, 1 one-half longer than its greatest width, 2 quadrate, 3 and 4 transverse; club compact, 6-jointed, the joints transverse. Thorax stout, from dorsal aspect one-fourth longer than its greatest width; pronotum narrowly visible, reticulate-punctate and with silvery pubescence; parapsidal furrows not indicated; scutum with large coarse confluent punctures with a faint reticulate tendency, and with very fine scattered pubescence; scutellum coarsely reticulate-punctate, the basal row of foveae very large and coarse. Forewings lightly and uniformly tinted, the submarginal, marginal, and median veins very faintly marked. Legs stout, the femora plainly swollen. Abdomen stout, somewhat wider than the thorax, barely twice as long as its greatest width; segment 1 one-half as wide basally as posteriorly, and somewhat shorter than its greatest width; 3 three-fifths as long as wide, a little shorter than 1 and 2 or 4-6 united; 1 strongly striate; 2 smooth, with a few pin-punctures laterally; lateral margins of 1 and 2 with dense silvery pubescence; 3 smooth, with scattered fine punctures laterally bearing fine hairs, and a row of sparse similar punctures toward posterior margin; 4 with about three rows of fine punctures at base, and scattered punctures laterally and posteriorly; 5 with numerous fine punctures; 6 densely, finely punctate and pubescent.

North Queensland: Cairns district, three females in April and June. Type, in the South Australian Museum.

A large species easily recognised by the absence of parapsidal furrows, coarse punctuation of the scutum, and the swollen femora.

Mallateleia rugosiceps, n. sp.

♀. Length, 1·85 mm. Dull black, the abdomen somewhat brownish; coxae fuscous, the legs testaceous, the femora and tibiae washed with brown; antennae black, the scape and pedicel deep brown.

Frons, vertex and cheeks with a dense wavy rugose sculpture which is more or less longitudinal; there are a few scattered punctures, obscure on account of the sculpture, and scattered stiff white setae; lower face and cheeks with strong striae converging to the mouth. Antennae much as in *M. punctatifrons*. Thorax stout; pronotum foveate-punctate and with stiff white setae; scutum with

scattered stiff setae near the anterior margin, the surface shining, with scattered punctures, the median lobe for its posterior half with several irregular longitudinal grooves; scutellum with strong anterior and posterior foveate rows, the transverse disc with numerous punctures and a few short rugae; postscutellum very prominent, one-half as long as the scutellum, strongly foveate; median carinae of propodeum very wide apart, from lateral aspect raised posteriorly in the form of obtuse tubercles. Forewings lightly stained; submarginal and median veins faintly represented, the marginal vein marked by a faint thick stigma. Legs slender, the femora and tibiae not noticeably thickened. Abdomen wider than the thorax, somewhat less than twice as long as its greatest width; segment 1 not one-half as wide basally as posteriorly; 3 as long as 1 and 2 or 4-6 united, two-thirds wider than long; 1 strongly striate; 2 very densely and rather strongly striate, but laterally the striae are sparse; 3 very densely and rather finely striate, the striae somewhat wavy, becoming very wavy and irregular laterally where scattered setigerous punctures are present; sculpture of 4 and 5 of dense fine irregular striae; 3-5 at base with a row of close punctures; 4-6 with a few scattered fine setae; 6 smooth.

South Australia: Owiendana, Northern Flinders Range, one female collected by Hale and Tindale. Type, in the South Australian Museum.

Distinguished by the rugose sculpture of the head, the grooves on the scutum, and the close fine striae of segments 3-5 of the abdomen.

Mallateleia westwoodi, Dodd.

Proc. Roy. Soc. Q'land, vol. xxvi., 1914, p. 92.

♂. Length, 1·95 mm. Black; femora, tibiae, and antennal scape fuscous; tarsi yellow.

Head with fine scaly sculpture, and moderately dense, not large thimble punctures, also short fine white pubescence. Scutum and scutellum with similar sculpture to the head; parapsidal furrows distinct and complete. Abdomen a little wider than the thorax; segment 1 striate; 2 with striae far laterally, smooth for the rest; 3 smooth medially, for the rest with very fine scaly reticulation; 4 and 5 wholly finely sculptured. Flagellar joints somewhat longer than wide.

North Queensland: Pentland, one male in September, A. A. Girault.

The original description states that the type is in the Queensland Museum, but there is no record of its having been deposited in that institution or in the South Australian Museum; probably it has been lost. The above diagnosis is based on the original description. Evidently closely allied to the male of *M. pilosifrons*, and it might well be the male of the species herein described as *M. pilosiscutum*.

Mallateleia pilosifrons, n. sp.

♀. Length, 1·80 mm. Dull black; coxae fuscous, the legs bright golden-yellow, the femora faintly dusky; antennal scape deep red, the pedicel washed with red; mandibles red, the teeth dusky.

Head normal; sloping sharply from the lateral ocelli to the occiput; lower face lightly depressed medially but without a definite depression; mandibles long, slender, tridentate; lateral ocelli against the eyes; frons with rather numerous small punctures and with a noticeable pubescence of short silvery appressed hairs; vertex with finer pubescence, similar punctuation, and also very finely coriaceous; toward the occiput the punctures are denser, subconfluent, and arranged subtransversely; cheeks with dense punctures and silvery pubescence; against the mouth on the lower cheeks and frons are a few converging striae. Antennal scape moderately long and slender; pedicel one-half longer than its greatest width; funicle joints smaller and narrower than the pedicel, 1 one-half longer than wide, 2 as wide as long, 3 and 4 wider than long; club compact, the joints

transverse. Thorax slightly longer than its greatest width; pronotum densely punctate and with short silvery pubescence; parapsidal furrows well marked and complete, not foveate or punctate; scutum with moderately small punctures, dense but not confluent, without pubescence except for scattered very short and fine hairs; scutellum transverse, its surface with a few punctures; postscutellum prominent, transverse, foveate. Legs slender, the femora not noticeably thickened. Forewings lightly smoky, almost hyaline at extreme base; no sign of venation except for a dark stigmal mark. Abdomen somewhat wider than the thorax, hardly twice as long as its greatest width; segment 1 one-half as wide basally as posteriorly, shorter than its greatest width; 3 as long as 1 and 2 or 4-6 united, two-thirds wider than long; 1 strongly striate, the striae inclined to fail medially; 2 for the most part smooth, striate laterally, and with a row of foveae at base; 3-5 uniformly punctate and without pubescence, the punctures not large, dense but well separated; 6 and posterior margins of 3-5 smooth.

♂. Striae on segment 1 of abdomen strong; 2 with a few short striae at base; 2 and 3 smooth, impunctate, except for light pubescence laterally and a scattered row of fine hairs against posterior margin; 4 and 5 with numerous fine punctures bearing fine pubescence; 6 densely punctate and pubescent. Antennae black, the scape deep brown; flagellar joints each a little longer than wide, 1 a little longer than 3, 2 a little shorter than 3; pedicel a little shorter than funicle 1.

Queensland: Westwood, near Rockhampton, one female, five males, in December, A. P. Dodd. Type, in the Queensland Museum. Allotype, in the South Australian Museum. Paratypes, in the author's collection.

Although all the specimens were taken in the same locality at the same time, the differences in the sculpture of segment 3 of the abdomen suggest that the male may be a distinct species.

Mallateleia maculipennis, n. sp.

♀. Length, 2 mm. Dull black, the thorax ventrally somewhat reddish; legs, including the coxae, orange-yellow; antennal scape yellow, the pedicel and funicle joints dusky-brown, the club black; mandibles yellow.

Head much as in *M. pilosifrons*; upper frons and vertex with numerous small punctures and dense fine impressed reticulation; behind the ocelli the reticulation bears a transverse appearance; lower half of frons with dense subconfluent punctures and a conspicuous pubescence of appressed silvery hairs; cheeks rather densely punctate and with silvery pubescence. Antennal scape slender, longer than the next five joints combined; pedicel one-half longer than its greatest width; funicle joints smaller than the pedicel, 1 one-half longer than wide, 2 quadrate, 3 and 4 wider than long; club compact, the joints transverse. Thorax normal; pronotum densely punctate and pubescent; scutum with moderately dense, rather small punctures and scattered fine pubescence; scutellum transverse, its disc impunctate or nearly so, and finely scaly; propodeum pubescent, the median carinae well apart; mesopleurae with several strong striae above the depression which is smooth except for a row of punctures posteriorly. Forewings definitely smoky, but the base is hyaline, and there is a square hyaline spot against the anterior margin at less than one-half its length; discal cilia exceedingly dense; venation hardly marked. Legs slender, the femora and tibiae not thickened. Abdomen somewhat wider than the thorax, twice as long as its greatest width; segment 1 much wider posteriorly than at base, somewhat shorter than its greatest width; 3 almost as long as 1 and 2 or 4-6 united, two-thirds as long as wide; 1 strongly striate, the striae failing laterally; 2 smooth for the most part, with a few strong striae laterally; 3 with dense fine longitudinal reticulation which changes to fine striation laterally, the median line almost smooth; 4 and 5

with fine scaly impressed reticulation; 6 smooth; 2-5 with a few fine hairs along the lateral margins, and a row of fine scattered hairs along the posterior margin of each segment.

Queensland: Brisbane, one female, A. P. Dodd. Type, in the Queensland Museum.

Very similar to *M. pilosifrons*, but distinguished by the hyaline spot in the wing, and the sculpture of segments 3-5 of the abdomen.

Mallateleia pilosiscutum, n. sp.

♀. Length, 1·75 mm. Dull black; coxae fuscous, the legs testaceous, the femora and tibiae faintly dusky; antennal scape brownish-yellow.

Head normal; with dense, fine, scaly, impressed reticulation, and small scattered punctures; behind the lateral ocelli the reticulation has a distinct transverse tendency; cheeks almost smooth, except for scattered punctures; pubescence very fine and scattered, but rather dense on the cheeks; no pronounced pubescence on lower face. Antennal scape moderately long and stout; pedicel one-half longer than its greatest width; funicle 1 small, barely one-half longer than wide, 2 quadrate, 3 and 4 wider than long. Thorax stout; pronotum with dense punctures and white pubescence; scutum with numerous, rather small, scattered punctures, bearing rather long white setae, the pubescence conspicuous; scutellum smooth except for a row of punctures bearing white setae against the anterior and posterior rows of foveae; median carinae of propodeum wide apart, the area between strongly foveate, the lateral areas punctate around the margins, smooth inwardly, and laterally with dense silvery pubescence; mesopleurae smooth for the most part, striate dorsally, and there is a row of punctures near the posterior border. Forewings lightly stained, almost hyaline at extreme base; venation hardly showing. Legs slender, but the femora and tibiae are a little thickened. Abdomen somewhat less than twice as long as its greatest width; segment 1 barely one-half as wide basally as posteriorly, shorter than its greatest width; 3 three-fifths as long as wide, a little shorter than 1 and 2 or 4-6 combined; 1 strongly striate, the striae failing laterally; 2 striate, the striae stronger laterally; 3 with a row of punctures at base, almost smooth medially, laterally with fine wavy impressed longitudinal lines; 4 and 5 with fine scaly reticulation; 6 smooth; sides of 2-5 with fine scattered pubescence; anterior and posterior margins 4 and 5 and posterior margin of 3 each with a row of fine scattered hairs.

Queensland: Biggenden, one female in January, A. P. Dodd. Type, in the Queensland Museum.

The sculpture of the abdomen is much as in *M. maculipennis*, but the striae are present across segment 2, and the scaly appearance of segment 3 is lost. At once differing from *M. pilosifrons* and *M. maculipennis* in the non-pubescent frons and the conspicuous pubescence of the scutum.

Mallateleia punctatifrons, n. sp.

♀. Length, 1·90 mm. Dull black, the abdomen somewhat brownish; coxae fuscous, the legs testaceous, the femora washed with brown; antennae wholly dark.

Head normal; upper frons and vertex smooth, with numerous scattered punctures of moderate size bearing short fine hairs; lower face with a pronounced and rather deep circular depression which is smooth, the area on either side with a few punctures above, smooth ventrally except for a few weak striae against the mouth; cheeks with several rows of punctures and rather long setae; toward the occiput, behind the lateral ocelli, are a few weak oblique irregular striae, and there is a row of short weak longitudinal striae against the occiput. Antennal scape rather stout; pedicel stout, two-thirds longer than its greatest width; funicle joints small, 1 one-third longer than wide, 2 quadrate, 3 and 4 transverse;

club stout and compact. Thorax stout; pronotum strongly densely punctate and pubescent; scutum smooth, with scattered rather small punctures bearing long white hairs; disc of scutellum smooth, but there is a row of small scattered punctures bearing long setae against the anterior row of foveae, and a similar row within the posterior line of foveae; propodeum and mesopleurae much as in *pilosiscutum*. Forewings slightly stained; thick indefinite lines indicate submarginal, basal, and median veins, and there is a faint thick spot to represent the marginal vein. Legs normal, the femora somewhat thickened. Abdomen somewhat less than twice as long as its greatest width; segment 1 not one-half as wide basally as posteriorly, and shorter than its greatest width; 3 almost twice as wide as long, a little shorter than 1 and 2 or 4-6 united; 1 strongly striate, smooth laterally; 2 striate, but the striae fail broadly medially; 3 rather weakly sparsely striate, but broadly smooth medially; 4-6 smooth, hardly sculptured; 3-5 at base each with one or two irregular rows of dense fine punctures; posterior margin of 2 and 3, and anterior and posterior margins of 4 and 5, each with a row of scattered pin-punctures bearing fine setae; sides of 3-5 with scattered setigerous punctures.

Queensland: Upper Burnett River, one female in January, A. P. Dodd. Type, in the Queensland Museum.

Agrees with *M. pilosiscutum* in the non-pubescent lower frons and the pubescent scutum, but differs in the absence of reticulate sculpture on the head and segments 4 and 5 of abdomen, the more definite frontal depression, and the definite striae on segment 3 of abdomen.

Mallateleia giraulti, Dodd.

Trans. Roy. Soc. S. Austr., vol. xxxvii., 1913, p. 151.
Mallateleia ashmeadi, Dodd, Archiv. fur Naturgeschichte, Berlin, 79, 1913, p. 168.

♀. Length, 2·15 mm. Bright orange or reddish-yellow, the margins of the scutellum and the sides of the thorax darker, the abdomen, except the third segment, dusky; eyes and ocelli black; legs wholly clear testaceous; first six antennal joints testaceous, the club black.

Head normal; frons and vertex smooth, with numerous scattered moderately small punctures each bearing a fine hair; a line of close punctures on either side of face against the eyes; punctures behind the lateral ocelli to the occiput sparse; punctures on cheeks dense but not confluent; lower cheeks and face with strong striae converging to the mouth; mandibles large, stout, tridentate, the outer teeth long and acute, the inner tooth small; face hardly depressed above the antennal insertion. Antennae as in *M. collaris*. Thorax stout, from dorsal aspect one-sixth longer than its greatest width; pronotum densely punctate and with fine pubescence; scutum smooth, with rather large and dense punctures bearing fine hairs, the parapsidal furrows very deep and broad; scutellum one-half as long as the scutum, the basal row of foveae large and coarse, its disc with large scattered punctures; postscutellum, propodeum, and mesopleurae much as in *M. collaris*. Femora and tibiae a little thickened. Forewings uniformly lightly stained, the venation not showing. Abdomen not more than twice as long as its greatest width; segment 3 a little less than two-thirds as long as wide, a little shorter than 1 and 2 or 4-6 united; 1 strongly striate; 2 smooth; lateral margins of 1 and 2 with a dense silvery pubescence; 3 smooth except for a few fine setigerous punctures far laterally and a scattered row of similar punctures near the posterior margin; 4 with a row of scattered fine setigerous punctures along anterior and posterior margins; 5 with numerous fine punctures bearing very fine hairs; 6 with rather dense fine punctures and pubescence.

♂. Length, 1·85 mm. Does not differ from the female except in its more slender form; there is a faint scaly reticulation on the vertex of the head, and the

punctures on segments 5 and 6 of abdomen are sparser; abdomen more slender, the basal segment as long as its greatest width and not widening greatly posteriorly; parapsidal furrows deep posteriorly, failing anteriorly. Antennae black, the scape testaceous; pedicel one-half longer than its greatest width; flagellum moniliform, pubescent, joints 3-9 subequal, each one-third longer than wide, 2 a little shorter, 1 a little longer and as long as the pedicel.

North Queensland: Cairns district; Cooktown; Pentland; three females, five males. Type, in the South Australian Museum, I. 1393.

The female closely resembles *M. collaris,* in which species the head, scutum, and scutellum are mostly black, the punctuation on segments 3 and 4 of abdomen is much denser, the legs are more slender, the abdomen is not so stout, and segment 3 is considerably longer in relation to its width, and the thorax is less stout. In *collaris*, the scutum is definitely longer in relation to its width, and its anterior margin is more strongly convex. Moreover, in *M. giraulti* the head slopes precipitously from immediately behind the lateral ocelli to the occiput, while in *collaris* this precipitous portion is much shorter and does not nearly reach the lateral ocelli.

MALLATELEIA GIRAULTI, Dodd, var. FOERSTERI, Dodd.

Mallateleia foersteri, Dodd, Proc. Roy. Soc. Q'land, vol. xxvi., 1914, p. 91.

♂. Length, 1·75 mm. Agreeing exactly with the male of *M. giraulti* except that the head is dark fuscous, the scutum and scutellum are mostly black, and the femora are somewhat dusky; forewings showing definite indication of submarginal, marginal, basal, and median veins; the punctures on the scutum are rather closer and denser.

New South Wales: Upper Tweed River, one male in May, A. P. Dodd. Type, in the South Australian Museum.

I hesitate to sink *M. foersteri* as a synonym of *M. giraulti;* it may represent the male of a female not yet known; on the other hand, it might possibly be the other sex of *M. collaris.*

Mallateleia collaris, n. sp.

♀. Length, 2·30 mm. Head black, around the mouth and mandibles bright red, the cheeks suffused reddish; thorax bright reddish-yellow, the scutum, except the parapsidal furrows, and narrowly along its margins, scutellum, and mesosternum, black; abdomen dusky-brown, the basal two-thirds of segment 3 intense orange; legs wholly clear testaceous; antennal scape testaceous, the pedicel and funicle joints suffused with yellow, the club black.

Head normal; no distinct impression above the antennae; frons and vertex smooth, with numerous scattered moderately large punctures, each bearing a fine hair; a line of close punctures on either side of the frons against the eyes; declivous area toward the occiput with smaller more scattered punctures; cheeks with large dense punctures; lower cheeks and frons against the mouth with converging striae; mandibles large, stout, tridentate, the outer teeth long, the inner tooth small. Antennal scape moderately long and stout; pedicel fully twice as long as its greatest width; funicle joints much shorter and a little narrower, 1 one-third longer than wide, 2 quadrate, 3 and 4 wider than long; club large, compact, the joints transverse. Thorax from dorsal aspect one-third longer than its greatest width; pronotum densely punctate and with fine pubescence; scutum smooth, with rather dense large punctures, each bearing a very fine seta, the parapsidal furrows very deep and distinct; scutellum with a few small setigerous punctures, the basal row of foveae very large and coarse; postscutellum rather prominent; propodeum punctate and with very fine pubescence, the median carinae straight and wide apart; mesopleural depression smooth, with a row of small punctures posteriorly, above with a few strong striae. Legs slender, the

femora and tibiae not noticeably thickened. Forewings reaching apex of abdomen, lightly stained, and with darker marks representing submarginal, basal, median, and marginal veins. Abdomen a little, yet distinctly, more than twice as long as its greatest width; scarcely wider than the thorax; segment 1 one-half as long basally as posteriorly; 3 three-fourths as long as wide, about as long as 1 and 2 or 4-6 united; 1 strongly striate; 2 smooth and shining; lateral margins of 1 and 2 with dense silvery pubescence; 3 smooth and shining, but with moderately dense punctures laterally, with a row of fine scattered punctures bearing fine setae near the posterior margin; 4 and 5 with one or two rows of dense punctures at base, for the rest with a few punctures medially and numerous punctures laterally, each bearing a fine seta; 6 with fine dense punctures and pubescence.

South Queensland: Chinchilla, two females in February, A. P. Dodd. Type, in the Queensland Museum. Paratype, in the author's collection.

This may possibly be the female of *M. foersteri*, but in that species the punctures of the head are smaller, there is a definite fine reticulation on the vertex, and segments 3-5 of the abdomen are without punctures. Closely related to *M. giraulti*, the differences being pointed out in the discussion on that species.

Mallateleia splendida, Dodd.

Mallateleioides splendidus, Dodd, Trans. Roy. Soc. S. Austr., vol. xxxvii., 1913, p. 152.

♂. Length, 2·15 mm. Reddish-brown, the head darker, the scutum and scutellum mostly blackish; abdomen brown, the third segment clear orange; eyes and ocelli black; legs testaceous; antennae black, the scape clear yellow.

Head normal; frons and vertex with large confluent or subconfluent punctures, behind the lateral ocelli to the occiput with a transverse arrangement, the pubescence very fine and inconspicuous; cheeks with dense punctures and fine pubescence. Antennae normal; scape rather slender; pedicel a little longer than its greatest width; flagellum moniliform, the joints shortly pubescent, 1 a little longer than the pedicel, 3 slightly shorter than 1, 2 quadrate and a little shorter than 3, 4-9 subequal, each slightly longer than wide. Thorax stout, one-fourth longer than its greatest width; pronotum densely punctate and with fine pubescence; scutum with large dense subconfluent punctures and very fine scattered pubescence, the parapsidal furrows well marked and complete; scutellum rather densely punctate, the basal row of foveae large and coarse. Posterior femora somewhat thickened. Forewings rather deeply brownish, but the infuscation is not regular; submarginal, marginal, basal, and median veins well marked by thickened darker lines. Abdomen stout, hardly twice as long as its greatest width; segment 1 widening posteriorly, hardly as long as its greatest width; 3 less than two-thirds as long as wide, a little shorter than 1 and 2 or 4-6 united; 1 and 2 strongly striate, without dense pubescence along the lateral margins; 3 and 4 smooth, with scattered minute punctures bearing fine hairs, the punctures denser on 5 and 6.

South Queensland: Roma, one male in October, A. A. Girault. Type, in the South Australian Museum, I. 1394.

Differs from *M. giraulti, foersteri,* and *collaris* in the dense punctuation of the head, dense striae on segment 2 of abdomen, and the absence of dense pubescence on the lateral margins of segments 1 and 2.

Mallateleia crassipes, n. sp.

♂. Length, 2·40 mm. Head black; thorax rich chestnut-red, the scutellum, most of the scutum, and the pronotum laterally, blackish; pleurae dusky; abdomen deep brown, blackish at base and posteriorly; legs reddish-yellow, the coxae

fuscous, the femora sooty; antennal scape dusky-red, the flagellum reddish at base, becoming fuscous toward apex.

Head normal, from dorsal aspect transverse; vertex sloping shortly to the occiput from some distance behind the lateral ocelli; eyes much smaller than usual and very wide apart; lateral ocelli distant from the eye margins by twice their own diameter; face not noticeably depressed; frons with rather dense small punctures and a noticeable pubescence of fine silky hairs; punctures of vertex larger and closer than on the frons; cheeks broad, rather densely punctate and pubescent. Antennal scape stout and somewhat swollen apically; pedicel stout, one-third longer than its greatest width; funicle 1 shorter than the pedicel, slightly longer than wide; 2 shorter than 1; 3 excised in a sharp point on one side; 4-9 shortly stalked and with short pubescence, each very transverse. Thorax stout, from dorsal aspect one-sixth longer than its greatest width; pronotum densely punctate and finely pubescent; parapsidal furrows distinct and complete; scutum much wider than long, its anterior margin obtusely convex, with dense moderately small non-confluent punctures and a conspicuous fine silky pubescence; scutellum smooth, with a few setigerous punctures at base, the basal row of foveae not coarser than the posterior row; postscutellum shorter than usual and not so conspicuous; propodeum with a light clothing of silky hairs. All femora stout and swollen; tibiae stout, the tarsi short and rather stout. Forewings slightly smoky, but the infuscation is streaky and not regular; darker lines represent submarginal, marginal, basal, and median veins. Abdomen twice as long as its greatest width; segment 1 shorter than its greatest width, one-half as wide basally as posteriorly; 3 two-thirds as long as wide, about as long as 1 and 2 or 4-6 united; 1 strongly striate; lateral margins of 1 and 2 with dense long pubescence; 2 smooth except for an oblique row of a few minute setigerous punctures laterally on the posterior half; 3 smooth, with a scattered row of fine setae at one-half its length, and a similar row near the posterior margin, its lateral margins with scattered fine setigerous punctures; 4 with numerous fine punctures bearing fine hairs; 5 and 6 rather finely densely punctate and pubescent.

South Queensland: Mount Tambourine, 2,000 feet, one male in April, A. P. Dodd. Type, in the Queensland Museum.

Readily distinguished from the known males of other species by the very short antennal joints and thickened legs. It cannot represent the opposite sex of any known female.

Mirotelenomus, Dodd.

Trans. Roy. Soc. S. Austr., vol. xxxvii., 1913, p. 173.

♀, ♂. Head from dorsal aspect transverse, a little wider than the thorax, its posterior margin gently concave; from lateral aspect thin, gently convex or almost straight from the posterior margin to the mouth; from frontal aspect much wider than deep, not or feebly depressed above the antennal insertion; eyes rather small, very wide apart, bare or faintly pubescent; ocelli situated in the centre of the vertex, the lateral pair very far from the eye margins; mandibles slender, long, bidentate. Antennae 12-jointed in both sexes; in the female the funicle joints short, the club 6-jointed; in the male the flagellar joints moniliform and rather short. Thorax from dorsal aspect stout, as wide or wider than long, the pronotum not or hardly visible; scutum and scutellum almost flat or gently convex; scutum large, the parapsidal furrows absent; scutellum semicircular; postscutellum very short, unarmed, or with a sharp tooth or spine at meson; propodeum very short and wide, its posterior margin straight or gently convex, its posterior angles sometimes with a stout tooth; from lateral aspect the thorax may be shorter than deep or somewhat flattened. Forewings short, not reaching beyond the apex of the abdomen; submarginal vein with a pronounced downward curve just before joining the margin; marginal vein short, the postmarginal long

or short or more rarely absent; stigmal vein normal or more rarely hardly developed. Abdomen somewhat flattened, very wide at base, not much longer than wide, the second segment the longest but not much longer than 1 or 3, 4-6 very short and transverse.

Type, by designation, *M. abnormis*, Dodd.

This genus was erected to contain one peculiar little species. On reflection, I have decided to widen its scope to contain all the Australian species described in the genus *Hadronotus*, Foerster, in which there is a distinct downward bend in the submarginal vein before it joints the costa; these species are *H. aquaticus*, Dodd, *parvipennis*, Dodd, *spinosus*, Dodd, *splendidus*, Dodd, *nigriceps*, Dodd, *orientalis*, Dodd, *angustipennis*, Dodd, *nigricoxella*, Dodd, *assimilis*, Dodd, *amplus*, Dodd, and *fumosus*, Dodd. Although showing some variation in the wing venation, and the teeth on the postscutellum and propodeum, the genus is a very natural one. It differs from *Hadronotus* mainly in the downward bend of the submarginal vein, and in the position of the lateral ocelli, which are not situated near the eye margins; lesser points of difference are the absence of a frontal depression on the head, the less convex scutum and scutellum, and the shorter wings. Several species of *Hadronotus* have been bred in Australia from heteropterous eggs, but there is no record of the host affinities of any of the species of *Mirotelenomus*; it would seem quite possible that eggs of some other order of insects are attacked. The species are small; the type species, *M. abnormis*, shows the extreme reduction of the venation, and the more flattened type of thorax.

Mirotelenomus armatus, n. sp.

♀. Length, 1·20-1·40 mm. Black; coxae fuscous, the legs bright reddish yellow; antennal scape reddish-yellow, the remaining joints fuscous.

Head very thin, the frons almost straight; vertex gently concavely margined across from the lateral ocelli, the surface behind this margin sharply depressed to the occiput; frons and vertex with dense fine impressed reticulation and numerous moderate-sized punctures bearing very short fine setae; above the antennal insertion the surface is feebly depressed, finely reticulate and without punctures; on either side toward the mouth with fine dense striae; cheeks smooth except for a few punctures; eyes bare; mandibles long, bidentate, the inner tooth long and acute, the outer tooth short and truncate. Antennal scape moderately long and slender; pedicel one-half longer than its greatest width; funicle joints hardly narrower than the pedicel, 1 as long as its greatest width, 2-4 much wider than long; club 6-jointed, the joints much wider than long. Thorax, from dorsal aspect, no longer than its greatest width; scutum with dense scaly reticulation and numerous scattered punctures bearing very short and fine setae; reticulation of scutellum finer, the punctures more scattered; postscutellum with a short tooth at meson; lateral angles of propodeum produced into a stout sharp tooth or spine. Forewings faintly smoky; marginal cilia short; venation thick and distinct, terminating before one-half the wing length; marginal vein short but longer than the very short stigmal vein, the postmarginal not developed. Abdomen stout; segment 2 a little longer than 1 and somewhat longer than 3; 1-3 with a distinct delicate carina some distance from the lateral margin; 1 strongly irregularly striate at meson, the sculpture gradually giving way laterally to fine raised reticulation; 2-4 with fine reticulation, raised on 2 which shows fine irregular longitudinal striae, impressed on 3 and 4; 1-3 outside the lateral carinae with fine impressed reticulation; anterior and posterior margins of 2-4, and posterior margin of 1, narrowly smooth; 2-4 near posterior margin with a row of fine setae; 5 and 6 very short, 5 with a row of setae.

Queensland: Brisbane, one female, A. P. Dodd; one female without further data collected by A. A. Girault. South Australia: Mount Lofty, one female

taken in moss by R. J. Burton. Type, in the Queensland Museum. Paratypes, in the South Australian Museum, and the author's collection.

Very much like *M. abnormis*, but in that species the stigmal vein is hardly developed, the marginal cilia are rather long, the scutum and scutellum are without punctures, the postscutellum and propodum are not spined.

Acolus scutellaris, n. sp.

♀. Length, 1·35 mm. Black; coxae black, the legs brownish-yellow and somewhat dusky, the tarsi pale; antennae fuscous.

Head, from dorsal aspect, transverse, the vertex thin; from frontal aspect, plainly wider than deep; eyes moderately large, with short scattered pubescence; ocelli very wide apart, the lateral pair against the eyes; surface very densely finely coriaceous and with a fine pale pubescence; above the antennal insertion there is a smooth area with a median carina. Antennal scape moderately long; pedicel twice as long as its greatest width; funicle joints small, narrower than the pedicel, 1 somewhat longer than wide, 2-4 transverse; club large, plainly longer than the pedicel, twice as long as its greatest width. Thorax stout; from dorsal aspect showing two sclerites only, namely, the scutum and scutellum, which are sculptured like the head; scutellum large, triangular but blunt at apex, not as long as its basal width, projecting over and hiding the postscutellum and propodeum as far as the base of the second abdominal segment; propodeum on either side armed with a sharp erect spine or tooth. Forewings rather short, barely reaching to apex of abdomen; distinctly clouded, the fumation deepest beneath the stigmal vein; venation very dark, terminating at one-half the wing length, the marginal vein short, the stigmal vein long, the postmarginal slightly developed; basal vein not showing. Abdomen stout, very broad at base, not much longer than its greatest width; segment 1 very short, transverse; 2 much longer than 1; 3 over twice as long as 2, and somewhat longer than 4-6 united; 1 and 2 strongly striate, the surface smooth before the striae; 3 less strongly striate, the surface finely coriaceous between the striae; 4-6 densely coriaceous and pubescent, also the lateral margins of 2 and 3.

South Australia: Adelaide, one female in flood *débris*, A. M. Lea. Type, in the South Australian Museum.

Readily distinguished from other Australian species by the produced scutellum.

FURTHER NOTES ON RADIO-ACTIVE ILMENITE NEAR MOUNT PAINTER.

By A. C. Broughton.

[Read October 14, 1926.]

The following is an extension of a note by the writer in vol. xlix. of the Transactions of this Society on "Radio-Active Ilmenite."

In that note the existence of a radio-active ilmenite in the Mount Painter district was recorded and an analysis quoted which confirmed electroscopic determination of radio-active properties of the mineral considered. The analysis demonstrated the existence of uranium (radio-active) and vanadium in the mineral.

The determination of the mineral as ilmenite was mainly on its physical properties such as crystallisation, colour, fracture, structure, hardness and streak, together with the occurrence of the decomposition product leucoxene in three directions in samples of the mineral determined. The chemical analysis was to confirm the titanium, uranium, and vanadium content.

The analysis, which was tentative, while confirming a radio-active property, also indicated that the titanium content was abnormally high.

The analysis given was:—TiO, 34·1; Fe, 17·8; U, 3·7; V, present.

For a normal ilmenite Dana gives:—O, 31·6; Ti, 31·6; Fe, 36·8.

The high titanium content suggested the presence of rutile TiO_2 associated with the ilmenite. This idea is confirmed by treating the mineral with hot hydrochloric acid for several hours, when towards the end of the decomposition normal red rutile separates out and the radio-active (uranium) constituent is found to remain in the acid solution.

Hand specimens of the mineral, collected subsequently to the receipt of the analysis quoted, showed numerous rutile needles distributed both in the ilmenite and associated gangue of felspar and quartz.

Adjoining the locality where the ilmenite occurs rutile exists associated with the copper-uranium-phosphate, torbernite, in a pegmatite, in pieces up to 5 inches long and 2 inches thick.

A sample from this occurrence forwarded to the Department of Mines was, under date of 8th December, 1925, described by Mr. W. S. Chapman, Departmental Analyst, as felspar, rutile, and torbernite, and the TiO_2 content given as 20·10% and UO_3 as 0·30%.

A sample of ilmenite considered typical of the occurrence in this vicinity was also forwarded to the Department of Mines, and under date of 15th April, 1926, was described as follows:—

"The sample was found to contain 48% titanium dioxide with a large proportion of iron, also cerium earths, etc., and about 5% uranium oxide. The analyst reports that the mineral, in general characters, resembles the Radium Hill mineral complex described by Crook and Blake as an admixture of ilmenite, rutile, and a mineral provisionally identified as tscheffkinite."

The rocks in the vicinity of the ilmenite occurrence consist of aplites, pegmatites, gneisses, gneissic and garnetiferous granites, fine-grained mica schists, and coarse biotite schists.

The gneisses and schists contain appreciable magnetite as specks and larger pieces in lenticles, up to 2 inches in length and ½ inch in thickness, and have been shown to contain up to 1·8% TiO_2. The granites also contain numerous specks of magnetite, but the titanium content has not been investigated.

The region is one of great metamorphism, and blocks of gneiss and schist can be seen completely enclosed in the acid granites and pegmatites. Some of the enclosed blocks are 2 feet in length, and their striated gneissic or schistose character is in obvious contrast to the more homogeneous crystallisation of the enveloping igneous masses. Zonal alteration, where the included rocks are in contact with the enclosing igneous rock, is a feature of the district. In many places quartz veins traverse both the enveloping igneous and included blocks of gneiss and schist, and in others coarsely crystallised pegmatites intersect the granites and included gneiss and schist, introducing a secondary phase in the contact metamorphism of the enveloped blocks.

Insufficient field work has been done as yet to determine the relationship of the ilmenite complex to the acid igneous rocks of the vicinity. It has been observed that the ilmenite is generally associated with gneiss or mica schist, but the rock-strewn nature of the district makes detailed mapping very difficult.

Work to determine whether the ilmenite complex had its origin in basic rocks that were intruded into a pre-existing metamorphosed area, or whether the ilmenite already existed in gneisses and schists which were subsequently intruded by magmas, is now being undertaken by the writer, and will form the basis of a paper dealing with other features of the district concerned.

MISCELLANEA.

NOTE ON TWO OCCURRENCES OF ARCHAEOCYATHINAE NEAR LAKE TORRENS.

By R. Lockhart Jack, B.E., F.G.S.

1. The specimens were in some chippings from a bore on Yarra Wurta Creek (portion of P.L. 1041A), near the north end of Lake Torrens. The driller's log showed:—

Feet.	
0 - 12½	Shaft with salt water at 12½ feet.
12½ - 27	Bands of gypsum.
32 - 45	Brown sandy clay.
45 - 50	Bands of lignite.
50 - 62	Blue clay.
62 - 90	Brown and blue clays.
90 -125	Layers of blue, brown, and yellow clays.
125 -130	White clay with salt water.
130 -145	Yellow and brown clays.
145 -184	Brown sandy clay.
184 -191	White clay with big supply of water testing 19 oz. per gallon.
191 -193	Band of lignite.
193 -202	White sandy clay with brackish water in small amount.
202 -209	———
209 -210	Very hard rock (purple limestone with Archaeocyathinae.—R. L. J.).
210 -213	Sandstone with large supply of water (a sample contained 3·18 oz. of salts per gallon.—R. L. J.).

Chippings from the 209-210 feet bed brought to the writer were forwarded to the National Museum, Melbourne, for determination of contained fossils. Mr. F. Chapman (Palaeontologist) reported that there were various types of Archaeocyathinae, and that a chip that was sliced showed "*Archaeocyathinae* c.f. *retezona*, Taylor." The occurrence is of interest, as it is the farthest north-west locality yet recorded in the State.

2. About six or seven miles to the south-west of Copley, on the Oodnadatta Railway, a bed of magnesian limestone several hundred feet thick strikes parallel to and forms a foothill of the Mount Scott Ridge. The bed dips about 30° to the N.E., and is probably identical with that of the Archaeocyathinae locality at the Ajax Mine, eight miles to the south-east.

Archaeocyathinae were not seen *in situ* at the Mount Scott locality, but weather-etched fragments of pink limestone were collected on the surface.

Evening Meeting, November 12, 1925.

NOTES ON THE MOTION FOR THE REGENERATION OF NATIVE FODDERS.

By S. Dixon.

I appeal to the Fellows of this Society to continue their support to the movement started in 1888 by the Field Naturalists' Section, and which rapidly spread to the rest of Australia, for the preservation of our peculiar and unique Fauna and Flora. I would also remind you that this Society, by its continuous and persistent action, finally secured the National Park as a Reserve. After many years' efforts Flinders Chase was secured from the South Australian Government for a similar purpose.

From an economic aspect the Flora, which is by far the more important, is still being ruthlessly and unintelligently destroyed over very wide areas, with the result of a tremendous financial loss to the community of £30,000,000 per annum, that being the difference in value between the number of sheep pastured in Australia, some thirty years ago, and now.

Hence it becomes important to take immediate steps not only to stop the wholesale destruction of our Flora, but to regenerate the pastures and counteract, as far as possible, the effects of this most costly destruction of Australia's wealth in the wool. In a paper read before this Society about thirty-two years ago I predicted how serious this loss would become in time and that, not only from the shortage of wool, but also as affecting the meat supply; this, too, is amply proved by present prices.

The only possible way of attaining to our former flock numbers is by continuous and systematic reproduction of our unrivalled fodder plants—reproducing them by suitable and correct methods of cultivation so as to regenerate them in a large and comprehensive scale throughout the arid regions which are purely pastoral.

The introduction of the motor tractor has now made it possible to stir up soils where necessary, and also the rapid seeding of large areas. In South Australia, alone, three-fourths of its surface has a rainfall of under 10 inches per annum, and much of that large area has never yet been stocked with sheep, the idea of cultivation may therefore seem quite superfluous and, as the rainfall is highly irregular, to be impossible of realization. This is not so. Take, for example, the North-East; that purely pastoral area now carries exactly half the sheep per square mile which it did fifty years ago. Cultivation is easily practicable, and the most important fodders are those shrubs and small trees the foliage of which, whilst ordinarily out of the reach of sheep, in droughts are the great standby. These may, collectively, be called "overhead fodders," which afford in the longest droughts an insurance against starvation. The most valuable of these are mulga *(Acacia aneura)*, wilga *(Hetro-dendron oleafolia)*, quondong *(Fusanus*, several species), sandalwood *(Myoporum undulatum)*, being the most important, and there are others. There is one tree very rare in Western Australia, Gregory's Kurrajong, which is an extremely valuable drought resistant.

The drought just ended in Queensland is stated to have caused the loss of 6,000,000 sheep, equal to this State's total flocks. Is it not a matter of the greatest national concern that a common-sense policy should prevail in preventing such large losses by systematically providing an insurance against them in cultivating fodders indigenous to each climatic zone? Will pastoralists and Governments

continue to ignore the teachings of science by which these huge losses might be lessened? The cost of hand feeding and transferring starving stock over long distances would have gone a very long way towards the cost of such a policy. The seeds of these native plants could be sown in ground already broken up in such seasons as the present, with a summer rainfall which ensures their germination and growth. Motor tractors to scarify hardened clay patches, especially around the watering places, would cause long-buried seeds of *Atriplex*, *Rhagodia*, etc., to germinate, and if the overhead fodders were broadcast at the same time a very certain insurance against loss would be provided. How long seeds may be buried underground without germinating in arid regions has never yet been settled, but the Koonamore Botanic Station may be expected to produce some evidences on this subject. Meanwhile the Survey Office records show that very large areas have been abandoned at various periods, but in most cases, after all the stock had been removed, a partial recuperation has taken place and the land has been leased again. To carry out this policy of regeneration an exact knowledge of the conditions, including temperatures and degrees of moisture, to ensure successful germination, is necessary. To obtain that knowledge should be possible, and the motion to offer a sum of money for the best paper on the subject seems to me to be the first and absolutely necessary step. Our Articles of Incorporation especially provide for such contingencies.

The primary principle involved in efforts to raise Australian flocks to their former numbers is to increase by every possible means the endemic flora peculiar to each rainfall zone. On the grassy downs of Queensland and New South Wales various acacias existed, and are especially worthy of cultivation, their astringent qualities being most useful in regulating the intestines, which, when out of order, afford such conditions as are most favourable for the propagation of the fly pest. In urging the necessity for cultivating judiciously our native fodder, it must be borne in mind that there are very extensive tracts where cattle, and not sheep, should be grazed.

When once the natural vegetation has been destroyed on these light and sandy soils it becomes impossible in a hot and arid climate to restore it, and these spots quickly become a drifting, dangerous, and sandy desert, such as happened exactly sixty years ago, on the 9th November.

A strong north wind was blowing, and soon after 9 a.m. it increased to half a gale, the sky became a red-opaque fog through which the sun's disc was faintly visible—the effect was ghastly, weird, and terrifying. At that time the exodus from the Far North was in full progress with the stock routes overcrowded with sheep, and the red surface soil was following them to the South-East, where it fell as mud. The northern ranges where it originated have never quite been the same since. On two or three occasions this has happened since, but only in a much milder form, but in the course of years the conditions brought about by destroying the permanent native vegetation must render it possible that dust-storms, as intense and destructive as in 1866, may occur. The widespread areas of drift-sandhills, if once denuded of *Triodia*, etc., may well cause apprehension, lest such centres of danger repeat the story of desolation seen in North Africa.

In asking this Society to take the first steps in a matter of such great concern to all Australia, and hoping my motion will be carried, it may be expected that the further steps should be outlined, and from a lengthened experience and intimate knowledge of our arid interior the following suggestions may be of some practical use:—

1. Legislation to induce pastoralists to improve by every means the growth and regeneration of the Flora peculiar to each climatic zone. The tenure must necessarily be long and secure; for instance, in the mulga country the conditions

of heat and moisture to ensure germination and continuous growth only occur at long intervals, sometimes three, and even more, years may elapse, and it might even be another ten years before it would be safe to graze it. The mulga, of all our fodders, is most surprising for its concentrated nourishment and for its drought-resisting qualities. It is, therefore, the most suitable of all desert plants for the regions of scantiest rainfall, and it would be possible, by systematic cultivation of this class of tree alone, to add 50 per cent. to the grazing capacity in arid country. In any scheme intended to supply conditions capable of restoring the Flora in a stocked run, small paddocks are essential to success (frequent changes being needed), but the high import duties render this difficult in country capable of keeping only 15 to 20 sheep per square mile.

2. Legislation will be needed to encourage cultivation and no rent should be chargeable in the special areas so treated until fit for grazing again, and sums so spent should be deducted from the assessable income, a principle already acted upon by the Federal Government in regulations with respect to Forestry.

3. All vermin must be destroyed, especially rabbits, which during droughts almost disappear. Slovenly management, allowing them to increase in good seasons, should be heavily punished by fine or even cancellation of lease, in the event of repeated offences. At present no quantity of the seeds needed are obtainable, but if the policy now outlined be adopted, it is only a question of supply and demand, as after good seasons there is an abundance produced.

In conclusion, contemplate what must be the inevitable results of grazing year in and year out on the same country, clearly only an annual vegetation can propagate; the perpetuation of permanent shrubs and trees becomes impossible, and the interior becomes a waste wilderness except for the very few weeks after rain.

The foregoing facts will, I hope, be sufficient as a plea for granting a sum bearing some relation to its importance as a commencement to "Advance Australia" in a subject of so very great importance to succeeding generations; possibly the money expended may awaken an apathetically indifferent public to the urgency of preserving our indigenous Flora, although the lack of interest with respect to our fast vanishing Fauna has been exceedingly disappointing.

It may be asked, Are there some fodder plants in other arid countries adapted to Australian conditions? There are a limited number worth experimenting with, and I trust the Waite Institute, besides forming a complete collection of Australian fodder plants, will investigate those from other countries that may possess a suitability for the climatic conditions of Central Australia.

Evening Meeting, October 13, 1926.

ABSTRACT OF THE PROCEEDINGS

OF THE

ROYAL SOCIETY OF SOUTH AUSTRALIA

(Incorporated)

FOR THE YEAR NOVEMBER 1, 1925, TO OCTOBER 31, 1926.

ORDINARY MEETING, NOVEMBER 12, 1925.

THE PRESIDENT (Prof. T. G. B. Osborn, D.Sc.) in the chair.

ELECTION.—Edward Julius, Conservator of Forests, as Fellow.

NOMINATIONS.—F. G. Holdaway, M.Sc., and B. B. Beck, as Fellows.

PAPERS.—Prof. W. HOWCHIN, F.G.S., read a paper on "The Geology of the Barossa Ranges and Neighbourhood in Relation to the Geological Axis of the Country." He stated that the fundamental rocks of Pre-Cambrian age constitute the geological axis of the Mount Lofty and associated ranges. They form an almost uninterrupted outcrop in a north-easterly direction from near Victor Harbour to the South Para River, near Williamstown, a distance of 58 miles. The failure to recognise this important datum line in the geological structure of the country has led to some wrong conclusions in the past. He suggested discarding the term Barossian, for the older series, in favour of the term Willyama introduced by Sir Douglas Mawson for the basal rocks in the Barrier Ranges of New South Wales. A long discussion followed. The President referred to the occurrence of eucalypts on the hard and soft rocks of the series. Sir D. Mawson regretted the removal of the term Barossian for the older series in favour of the term Willyama, and said that the identity with the Willyama series still remained to be proved. Mr. Thomas, B.Sc., referring to ilmenite, thought it was no criterion of the age of a rock. Mr. Hossfeld, B.Sc., was of opinion that the Barossian could be divided according to the prevalence of gneiss or mica schists. Mr. L. Keith Ward, Government Geologist, said that we owe Prof. Howchin a debt of gratitude for his courage in putting forward a section and admitting the difficulty of certain parts of the series. Dr. Lendon discussed the origin of the name Barossa.

Dr. R. PULLEINE contributed two short papers—(1) "Aboriginal Cave Paintings and Rock Drawings at Mootwingee, New South Wales"; (2) "Cylindro-conical Stones from Arcoona and Pimba, South Australia." These papers were illustrated by exhibits and a series of photographs of petroglyphs and stencil pictures projected on the screen.

EXHIBITS.—Prof. SIR DOUGLAS MAWSON, F.R.S., exhibited a series of ancient basic lavas from the vicinity of Wooltana Head Station. These are described as interbedded with sediments, ashbeds, and agglomerates, forming a thick series apparently underlying glacial beds which appear to belong to the Sturtian tillite of the Adelaide series. Also a specimen of limestone from Balcanoona Head Station in which rather indistinct fossil markings occur. Although undefined, these fossil traces are regarded as Archaeocyathinae. Mr. L. K. WARD exhibited a fine set of boulders strongly striated by ice action which were sent to the Geological Survey Office by Mr. J. Meagher. They were obtained

at Mount Dutton, at a place three miles to the west of the railway siding. All of them are stated to have been found resting on the Pre-Cambrian slates of Mount Dutton. Mr. R. L. JACK reported two occurrences of Archaeocyathinae near Lake Torrens. One of these (Yarra Wurta) is the farthest north-west locality yet recorded in this State for these fossils (see Miscellanea). Mr. A. M. LEA exhibited twigs of *Eucalyptus* from Mount Remarkable heavily encrusted with lerp scales (Psyllidae) that were seriously injuring thousands of trees and killing many young ones. The lerps were attacked by many kinds of parasites. He also showed specimens of *Aphelinus mali*, a minute chalcid wasp now being introduced by the Department of Agriculture to control the woolly aphis of the apple.

ORDINARY MEETING, APRIL 8, 1926.

THE PRESIDENT (Prof. T. G. B. Osborn, D.Sc.) in the chair.

THE PRESIDENT read invitations from the French Society of Industrial Chemistry, at Brussels, and the International Congress of Librarians and Bibliophiles, at Prague, inviting Fellows to their respective Congresses.

NOMINATIONS.—Miss E. D. Macklin, B.Sc., J. W. Wainwright, B.A., A. P. R. Moore, B.D.S., and A. Grenfell Price, M.A., as Fellows.

ELECTIONS.—B. B. Beck and F. G. Holdaway, M.Sc., as Fellows.

BY-LAW.—Prof. HOWCHIN reported that the Council proposed to submit to the next general meeting an alteration in the by-law concerning Corresponding Members.

Prof. T. G. B. Osborn and Prof. Prescott were nominated as delegates to the Perth meeting of the Australasian Association for the Advancement of Science, August, 1926. The local Secretary (Mr. L. K. Ward) reported on the arrangements for that meeting.

PAPERS.—Prof. W. HOWCHIN, F.G.S., read a paper on "Some References to the Literature concerning the Extinct Emus of Kangaroo Island and Elsewhere." Prof. Cleland stated that Mathews, in "The Birds of Australia," went fully into the question of the extinct races of the emu. Mr. Tindale referred to the finds of bones in the sandhills and in pits at Kelly's Hill, immediately to the east of South-west River, Kangaroo Island. Mr. A. M. Lea stated that on a visit to King Island some years ago he saw emu bones in great numbers and obtained many specimens.

SIR DOUGLAS MAWSON and P. S. HOSSFELD presented a paper on "Aboriginal Occupation in the Olary District," and described interesting cave paintings and other remains.

EXHIBITS.—THE PRESIDENT showed specimens of *Mesophellia arenaria*, a fungus belonging to the Gasteromycetes (puffballs) collected at Kangaroo Island. The fruit bodies are small spheres up to 1 inch in diameter, and when fresh have a smell resembling acetylene gas. Native animals are said to dig up and eat the hard centre. Mr. E. H. ISING exhibited a Western Australian Hakea *(H. platysperma)* from Korrongorrung. Dr. T. D. CAMPBELL showed a number of small aboriginal stone implements called "Chipped-back Knives." A number were recently collected at the Burra. They are found at almost all native localities in the Far North and have been collected on camp sites as far south as Normanville. Mr. A. M. LEA exhibited Australian plant weevils, subfam. Gonipterides, most of which eat the leaves of the eucalypti in their larval and adult stages. One species, *G. scutellatus*, has recently been accidentally introduced into South Africa and New Zealand, where it is now seriously injuring trees. An attempt is shortly to be made to introduce its parasites in both places. Dr. R. PULLEINE exhibited a small churinga from Alice Springs, said to be carried as a charm by the Kurdaitcha.

Ordinary Meeting, May 13, 1926.

The Vice-President (Sir D. Mawson, D.Sc., F.R.S.) in the chair.

Nominations.—For Hon. Fellows, Sir Baldwin Spencer, K.C.M.G., F.R.S., etc., and Frederick Chapman, A.L.S., F.R.M.S., who were supported by their respective proposers, Mr. L. K. Ward and Prof. Howchin. Mr. Ward stated—There is probably no living investigator to whom we, as a Society and as individuals, owe a greater debt than to Sir Baldwin Spencer. He came from Oxford to Melbourne to occupy the Chair of Biology, which he filled from 1887 to 1920, when he retired and received the title of Emeritus Professor. He has made many contributions to our knowledge of the fauna of the Australasian Region, the most notable being the study of the presence and structure of the pineal eye in Lacertilia. He was Zoologist of the Horn Expedition to Central Australia in 1894, and wrote not only several chapters dealing with the mammalia, amphibia, and crustacea, but also the narrative of the Expedition, and acted as Editor for the whole of the voluminous report. On this journey he met F. J. Gillen, and they became associated in investigating the culture of the aboriginal inhabitants of the centre of the continent, and published a series of works on the anthropology of the Northern Territory as well as the book entitled "Across Australia." Sir Baldwin Spencer acted also, during the early stages of the administration of the Northern Territory by the Commonwealth Government, as Special Commissioner and Chief Protector of the Aborigines. In recognition of his distinguished contributions to science, Sir Baldwin has had many honours conferred on him. He is an Honorary Fellow of Exeter and Lincoln Colleges in Oxford; a Fellow of the Royal Society; a Corresponding Member of the Zoological Society of London; and an Honorary Fellow of the Anthropological Institutes of Great Britain, Italy, and Washington. He has been President of the Royal Society of Victoria, and President of the Australasian Association for the Advancement of Science. Prof. Howchin said—Mr. Frederick Chapman came of a good scientific stock. His father, Robert Chapman, was assistant to Professor Tyndall. Frederick Chapman, the son, was assistant in the Geological Department of the Royal College of Science, London. He was elected an associate of the Linnean Society in 1896; received the Lyell Fund of the Geological Society of London in 1899; appointed Palaeontologist in the National Museum, Melbourne, in 1902; appointed Lecturer and Demonstrator in Palaeontology, University of Melbourne, in 1920; and in the same year was awarded the Symes Gold Medal and Prize for Research. He has given valuable assistance in Palaeontology, not only to workers in South Australia, but throughout the Commonwealth. He has published important text books on "The Foraminifera" and on "Australasian Fossils"; while his contributions to Australian Palaeontology, in serial literature, are particularly voluminous.

Nominations.—Leo Murtho Abell and Chas. P. Mountford, as Fellows.

Elections.—J. W. Wainwright, B.A., A.I.C.A., A. P. R. Moore, B.D.S., A. Grenfell Price, M.A., and Miss E. D. Macklin, B.Sc., as Fellows.

The alteration in the by-law concerning Corresponding Members presented to the General Meeting was unanimously ratified, and is reproduced in the Annual Report.

Papers.—Sir Douglas Mawson, "Additions to the South Australian Mineral Record." The following were recorded and exhibited:—Andalusite, Chiastolite, Columbite, Hyalite, Aventurine Sagenitic Quartz with Apatite, Brown Sphene, Grey Sphene, Leucoxene, Alunite, Piedmontite, Plumose Mica, Vesuvianite, Albite, Biotite, and Volborthite.

C. T. Madigan, M.A., B.Sc., read a paper on "The Geology of Fleurieu Peninsula, Part II., Organic Remains below the Archaeocyathinae Limestone at Myponga Jetty." Prof. Howchin congratulated Mr. Madigan on securing a slab

of rock of such an interesting although obscure character. The surface seen in relief may have had an organic origin, or it may not. In the Palaeozoic rocks it is often difficult to discriminate organic remains from inorganic structures. This has proved a pitfall into which many unwary geologists have fallen to their sorrow. Prof. Forbes named an impression on the Cambrian slates *Oldhamia antiqua*, as the supposed remains of a fossil alga, but it has long since been proved to have had an inorganic origin. Prof. King, of Durham, named and described a supposed coral from the Carboniferous limestone of the North of England, which turned out to be a living lichen. For a quarter of a century there was a heated controversy in the scientific world over a supposed Laurentian fossil, described by Sir Wm. Dawson under the name *Eözoon canadense*, as a gigantic foraminifer, and, possibly, the earliest animal organism, which built reefs in the primordial ocean. Dawson was backed by no less an authority than Dr. Carpenter; but it was ultimately proved to be the result of inorganic mineral penetration in a metamorphic rock. If the slab before us contains organic remains they are only casts, and their origin difficult to assign. Mr. L. K. Ward agreed with Prof. Howchin on the importance of distinguishing organic from inorganic remains, and instanced in Tasmania a great deposit of annelid sandstone where all the burrows were transverse to the bedding plane, whereas in Mr. Madigan's specimen they are *in* the bedding plane.

Prof. Howchin said he wished to refer to a matter that had reference to the naming of the Fundamental Rocks as they occur in South Australia. In a paper read by him at the November meeting of the Society last year on "The Geology of the Barossa Ranges and Neighbourhood," he had shown that the name Barossian, given to the rocks by Dr. Woolnough, was inappropriate and misleading, and therefore must be dropped, and suggested that the name Willyama, used by Dr. (Sir) Douglas Mawson for a series of rocks in the Broken Hill district, that were older than the Adelaide series, might be substituted. In the discussion that followed, Sir Douglas Mawson stated that he was not sure that the older series in New South Wales could be correlated with the Fundamental Rocks in South Australia. Under such circumstances, Prof. Howchin stated, the term Houghtonian might be adopted, inasmuch as the most detailed work on these oldest rocks of the State had been carried out by Dr. Benson at Houghton and neighbourhood, and the results printed in the Society's Transactions. Dr. Benson correlated these rocks with those of other localities which possessed characteristics that could be distinguished as the Houghton Magma. The term Houghtonian, therefore, was appropriate and convenient, as the type district was within a few miles of Adelaide. Mr. Thomas said that, following Prof. Benson, he considered the Houghtonian Magma more chemical than mineralogical. Mr. Madigan said he would be sorry to see the term Houghton Magma used in this connection, and thought at this stage it was not advisable to enlarge the field of the term. Mr. Ward said it would be impolitic at this stage to attach the name Houghton Magma to any broad grouping of these rocks, and it was not important at this stage to give a name to their classification. Sir D. Mawson remarked that as the older rocks were being worked at it would probably be proved shortly that the so-called Barossian is really composed of two series, for one of which the term Barossian might be retained. At present Mr. Hossfeld is doing extensive work in this connection.

Exhibits.—Prof. F. Wood Jones exhibited crescents, or chipped-back knives, from Mendian Hills, Central India, and Australia, and drew attention to their importance in culture and where scarification was practised, but from that did not try to deduce any racial continuity. Mr. A. M. Lea exhibited insects from the Cocos Islands, chiefly Coleoptera, introduced by commerce.

Ordinary Meeting, June 10, 1926.

The President (Prof. T. G. B. Osborn, D.Sc.) in the chair.

Elections.—Sir Baldwin Spencer, F.R.S., and Mr. Frederick Chapman, were elected Honorary Fellows; Leo Murtho Abell and Chas. P. Mountford were elected Fellows.

Papers.—Prof. W. Howchin, on "The Geology of Victor Harbour, Inman Valley, and Yankalilla, with Special Reference to the Great Inman Valley Glacier of Permo-Carboniferous Age." Sir Douglas Mawson was interested in the evidence of the oldest (Sturtian) glaciation being farther south than had been previously recorded. He also remarked that the fact that the bed of the ancient Permo-Carboniferous glacier is now below sea level does not definitely indicate either a rise or fall of the land relative to the sea level since that time. Glaciers are well known to have the power of eroding below sea level. The Government Geologist (L. K. Ward) said that it was interesting to learn that a point of contact between the Permo-Carboniferous and the Sturtian tillite had been discovered. Previously it had been known that the Permo-Carboniferous glacier must have moved over some area of the Sturtian tillite, because boulders of the earlier tillite were included in the tillite of a younger age at Hallett's Cove.

Prof. F. Wood Jones, D.Sc., F.Z.S., presented a paper on "Some Observations on the Flight of Sea Birds." He disclaimed treating the flight of sea birds from a mathematical point of view. His remarks were based on his observations of sea birds from the deck of a ship. He had noticed the different species of birds—albatrosses, gulls, terns, etc.—follow the ship only over certain areas of the ocean, and then refrain from further pursuit. Mr. E. Ashby and Mr. Edquist commented on the paper. Dr. Morgan mentioned that the skua's nest had not yet been found in the southern hemisphere.

Mr. F. G. Holdaway, M.Sc., "A Note on the Occurrence of the Rat Mite *Liponyssus bacoti*, in South Australia, together with Descriptions of Certain Stages."

Mr. A. M. Lea, F.E.S., "Notes on some Miscellaneous Coleoptera, with Descriptions of New Species, Part IV."

Dr. A. Jefferis Turner, F.E.S., "Studies in Australian Lepidoptera."

Messrs. Norman B. Tindale and C. P. Mountford, "Native Markings on Rocks at Morowie, South Australia."

Exhibits.—Mr. E. Ashby exhibited *Pteris tremula* and recorded a new locality for it. It was found growing in the crevices of an overhanging cliff at a waterfall in the Upper Hindmarsh River, about 10 miles from Victor Harbour. The fronds were picked during May, 1926. The first record of this fern in South Australia was in May, 1915, at the Royal Society meeting, when he exhibited specimens from the Murray cliffs. Other localities, mentioned by Mr. Black, are Streaky Bay and Glencoe (S.E.). Mr. N. B. Tindale, on behalf of Mr. P. Stapleton, exhibited kidney-shaped implements from near Fulham, found on native camp sites at various times since 1896. Two natives, believed to be from Goolwa, some years ago, told him that these implements were used for scraping skins, the latter being hung over a smooth pole during the operation. Dr. T. D. Campbell exhibited similar native slate objects with incised markings.

Ordinary Meeting, July 8, 1926.

Nominations.—Dr. C. S. Hicks, M.Sc., Dr. H. A. McCoy, and Mr. C. B. Piper, B.Sc., as Fellows.

Papers.—"Revision of the 'Sweet' Collection of Triassic Plants from South Australia," by Frederick Chapman, A.L.S., F.R.M.S., and I. Cookson, B.Sc.

(communicated by Mr. L. K. Ward). These fossils were collected at Leigh Creek in 1890 while the mine was being opened up. Etheridge, in 1892, made a brief report on them as an Appendix to H. Y. L. Brown's Report on the Leigh Creek Coal Mine. They are more fully dealt with by the same author in the Trans. Roy. Soc. S. Austr., vol. xix., pt. 2. The President said that the paper was very interesting to botanists on account of the description of plant remains in an important period in which the evolution of the flowering plant commenced. There was no mention of an angiosperm in the present collection, which comprised Equisetales, Filicales, Gingkoaceae, and Coniferae. Prof. Howchin stated that the known flora from the Lower Mesozoic rocks of South Australia is of such a limited character that any additions to our knowledge in that direction is most acceptable. The blending of a Jurassic and Triassic facies in the Lower Mesozoic flora of Australia led to the compound designation of Trias-Jura. The Leigh Creek beds were previously supposed to possess a preponderance of Jurassic forms, and were consequently so named. The present authors, whose careful determinations of the material extant merit much commendation, have now reversed the order, having shown a preponderance of plants of a Triassic type in the material. This is an important diagnosis in its bearing on the geological age of the Mesozoic rocks of South Australia. Sir Douglas Mawson expressed satisfaction that the extensive collection had been worked out.

Sir Douglas Mawson then gave a paper on "Varve Shales, associated with the Permo-Carboniferous Glacial Strata of South Australia." He drew attention to the occurrence of varve beds associated with the Permo-Carboniferous tillites of the southern Mount Lofty Ranges. They are in the nature of fluvio-glacial depositions in former rock basins and ponded lakes of limited areas. Reference was made to the importance of varve banding in fluvial sediments as one criterion of glacial conditions existing at the time of deposition. Attention was drawn to the existence of highly laminated, apparently varve slates in strata unconformably underlying the Sturtian tillite horizon in the north-eastern area of the State. This is regarded as highly suggestive of a still earlier glacial epoch in the Australian region. Prof. W. Howchin remarked that the two specimens exhibited by Sir Douglas Mawson were interesting as having some resemblance to the *varve* structure in some aqueo-glacial deposits. It is only under special conditions that a regular seasonal alternation of deposits can take place. The general conditions required were either an outspread delta-like area in front of the glacier, or, otherwise, a lake in the line of drainage from the glacier so as to secure relatively still water. Under such conditions the stronger flow from the glacier in summer carries coarser material which is dropped first, and the finer material is carried on. The lesser winter flow carries only the finer material, which is laid down on the coarser, and thus a regular alternation of coarser and finer material occurs in the annual deposits. By counting these seasonal deposits an estimate of time can be made as in the annual rings of an exogenous tree. The most important work on the subject was published in 1919 by Prof. Sayles in a Memoir issued by the Harvard University. All banded clays do not arise from seasonal deposition, or even from glacial action at all, and Prof. Sayles admits that the theory is only in a tentative stage, and that many observations must be made on the deposits of existing glaciers before the theory can be placed on a scientific basis. The South Australian examples are of a very local and limited character, and of little value for chronological purposes. Mr. Ward asked Sir Douglas Mawson if bores had ever been put down at the foot of a marine glacier where it was calving to see if varve sedimentation was taking place. Prof. Mawson replied that he did not know of any such investigation. Prof. Prescott gave an account of sedimentation researches by Prof. Oden, of Stockholm, which were of interest and value to geologists in the interpretation of deposits of this character.

"The Aborigines of South Australia: Anthropometric and Descriptive and other Observations recorded at Ooldea," by T. D. CAMPBELL, D.D.Sc., and A. J. LEWIS, M.B., B.S. This paper consisted chiefly of the tabulation and account of detailed measurements on 26 natives, and descriptive notes on their hair, eyes, skin colour, scars, and other features of interest to the physical anthropologist. Notes were also made on pathological conditions and the teeth. Along with the detailed observations interesting work was done in collecting native chipped stone implements, recording vocabulary, and making psychological notes. Attempts were made at recording corroboree songs on phonograph records, and some valuable information was secured in this line of research. Full-face and profile photographs were taken of all the natives examined, and some interesting moving pictures were made of general camp life, native crafts, and views of the natives themselves. Small collections were also made in other branches of natural history. The paper was illustrated by cinematograph films and lantern slides depicting water quest from trees, hut building, type of natives, etc. Time did not allow of any discussion on this paper.

ORDINARY MEETING, AUGUST 12, 1926.

THE VICE-PRESIDENT (Sir Douglas Mawson, D.Sc., F.R.S.) in the chair.

ELECTIONS.—Dr. C. S. Hicks, Dr. H. A. McCoy, and Mr. C. S. Piper, B.Sc., were unanimously elected as Fellows.

THE CHAIRMAN announced the publication of the Pan-Pacific Congress Proceedings, Australian Meeting, 1923.

PAPERS.—"The Wooltana Basic Igneous Belt," by SIR DOUGLAS MAWSON, D.Sc., F.R.S. Mr. Madigan said he found it difficult, on account of great metamorphism, to determine igneous from metamorphic rocks, and it was very important to fix the igneous horizon. Mr. Hossfeld said in discussing tillites that he had never been satisfied with the Adelaide Series as determined at present. The investigations of Mr. Jack and others will help to fix the age of the tillites.

"On the Propriety of Introducing Insects to Control Prickly Pear in Australia," by Prof. HARVEY JOHNSTON. This paper gives an account of the investigations and enquiries made, and the precautions taken, in regard to the various species of prickly pear insects introduced into Australia, the restricted plant relationships being emphasized. Mr. Lea said he had been for years interested in the control of insects by parasites. As an example of controlling plants by insects he instanced *Lantana,* where a parasite on the fruits had been introduced in Queensland and Fiji. It is noticed that there is a decrease in seedling Lantanas as the result of this. He referred to hyperparasitism as the great factor tending to defeat the usefulness of introduced parasites or insects. Notable successes in parasitic introduction were the *Novius cardinalis* to attack the cottony cushion scale in California and South Africa, and in the introduction of *Cryptolaemus* into Fiji. Mr. J. F. Bailey, who was formerly a member of the Queensland Prickly Pear Board, referred to the success of the introduced wild cochineal in exterminating *Opuntia monocantha* and its failure to attack *O. inermis,* the real pear pest. At present Dr. Bancroft was crossing *inermis* and *monocantha* to try and carry over the cochineal to the bad pear.

"The Review of Australian Isopods of the Cymothoid Group, Part II.," by H. M. HALE. This most interesting paper contained references to parasitism on fishes and protandric hermaphroditism.

"Ecological Notes on South Australian Polyplacophora," by E. ASHBY, M.B.O.U.

EXHIBITS.—Mr. ASHBY exhibited a minute marine plant collected at Yallingup, in October, 1920. Dr. Harvey Johnston identified it as *Halimeda opuntia,*

and said that coral islands and reefs owed much of their formation to *Halimeda*. Dr. Pulleine had seen the same plant at Vivonne Bay, Kangaroo Island, and, commonly, on the west coast of Tasmania, especially north of Mount Cameron West and at Sandy Cape. Mr. A. M. Lea exhibited a remarkable scale insect of the genus *Ourococcus*, the only evidence of which was a thin cotton-like fibre projecting from eucalyptus bark, the insect itself being completely hidden. Also some remarkable galls of the genus *Apiomorpha;* the male galls are minute and attracted to the female in considerable numbers. Also weevils—*Eucnemidae*, a mantis, and orthoptera collected by Dr. T. D. Campbell at Ooldea. Mr. A. A. Simpson, C.M.G., exhibited a beautifully polished stone axe dug up in a cottage garden at Burnside. Dr. Pulleine recognised the basalt-like rock as that of which the larger axes of the same shape are made in south-east New Guinea, and said by Seligmann, in "Melanesians of British New Guinea," that the stone was only to be found on Woodlark Island.

Ordinary Meeting, September 9, 1926.

In the absence of the President and Vice-Presidents, Sir J. C. Verco was voted to the chair.

Nomination.—H. A. Prockter, merchant, Adelaide, as Fellow.

Notice of Motion, by Mr. Samuel Dixon—"This Society views with alarm the destruction of our endemic fodder plants, as causing throughout Australia a serious diminution of our export of wool, and offers the sum of £250 for the best paper on the regenerative reproduction, germination, and cultivation of the flora of the saltbush areas of Australia."

Papers.—"Note on the Distribution of *Mycorrhiza*," by G. Samuel, B.Sc. Mr. A. M. Lea said that during a recent visit to the Lower North he noticed that nematode worms were doing injury to wheat crops.

"Species of the Isopod Family Sphaeromidae from the Eastern, Southern, and Western Coasts of Australia," by W. H. Baker.

Exhibits.—Mr. A. M. Lea, on behalf of Mr. F. J. C. Tooke (present as a visitor), exhibited a weevil *(Gonipterus scutellatus)* which is doing great damage to eucalyptus plantations in South Africa. Also some parasites (a mymarid wasp and a tachinid fly) found attacking its eggs and larvae in South Australia, and which it is hoped to introduce into South Africa. Mr. Tooke said that specimens of parasites have already been sent to South Africa. Mr. R. G. Thomas exhibited a small tube of radium bromide extracted from Mount Painter ore at the works of the Australian Radium Corporation, Dry Creek, S.A. Mr. Hale showed a crab, *Huenia proteus* (first dredged in South Australian waters by Sir Joseph Verco), and the seaweed *Halimeda* on which it is usually found.

Annual Meeting, October 14, 1926.

The Acting-President (Prof. F. Wood Jones, D.Sc., F.Z.S.) in the chair.

Nominations.—P. D. Riddell and P. de S. Stapleton, as Fellows.

Election.—H. A. Prockter, as a Fellow.

Mr. Samuel Dixon proposed the motion of which he had given notice regarding the endemic fodder plants of Australia. Mr. Champion Hackett seconded the proposal, which was supported by Mr. Selway, who eulogised Mr. Dixon on his successful efforts in securing the National Park and Flinders Chase. Prof. Harvey Johnston said that the first part of the motion was the more important. The proposal really raised two questions, one a Commonwealth and the other a State affair. The two portions of the proposal should be disentangled,

and the State Advisory Council should back up the National Research Council. Mr. Dixon's motion should be sent on to that Council, who were on the lookout for problems. He proposed as an amendment—"That this Society views with alarm the destruction of our endemic fodder plants, and respectfully asks the Council of Scientific and Industrial Research to take the matter up as an affair of national importance and extreme urgency." SIR JOSEPH VERCO, in seconding the amendment, eulogised Mr. Dixon for his work in the past, especially in reference to the Royal Society, and said it was his proposal in 1902 that led to the Society being incorporated, and so having its endowment fund. Sir Joseph further pointed out that the Society spends all the subscriptions and interest on endowment, as well as the Government subsidies, chiefly on the publication of the annual volume of Transactions. From the financial point of view, he thought we ought not to offer such a prize, as the Government might view it with alarm. Besides, the retiring President (Prof. Osborn) is engaged on the subject of vegetation, etc., in the arid North, and gave his opinion in his letter to the Secretary. Prof. Harvey Johnston's amendment was carried.

PAPERS.—"Additions to the Flora of South Australia, No. 24," by J. M. BLACK; "Australian Hymenoptera Proctotrypoidea, No. 5," by ALAN P. DODD; "Australian Coleoptera, Pt. 5," by A. H. ELSTON; "The Aborigines of South Australia: Native Occupation of Eden Valley and Angaston Districts," by PAUL S. HOSSFELD, B.Sc.; "Further Notes on Radio-active Ilmenite near Mount Painter," by A. C. BROUGHTON.

Prof. HARVEY JOHNSTON, in referring to the projected departure of the President, said the Society ought to put on record its congratulations to the President on the honour conferred on him by the Rockefeller Institute.

The ANNUAL REPORT and FINANCIAL STATEMENTS were read and adopted.

ELECTION OF OFFICERS.—In nominating Prof. F. Wood Jones as *President*, SIR JOSEPH VERCO said the Professor had done an exceedingly large amount of important work, and it was not only for the purpose of expressing appreciation of that work, but so that the Society might be honoured by having the Professor's name connected with it as its President that he nominated him, although they knew he was shortly leaving the State. In accepting the position, the Professor stated that he would not be able to occupy it for the whole term. He appreciated the honour, and would carry out his duties to the best of his ability while here. *Vice-Presidents,* Prof. T. G. B. Osborn and Prof. J. B. Cleland; *Members of Council,* Sir Joseph Verco, Prof. Harvey Johnston; *Treasurer,* Mr. B. S. Roach; *Auditors,* Messrs. W. Champion Hackett and Howard Whitbread.

ANNUAL REPORT

FOR YEAR ENDED SEPTEMBER 30, 1926.

The activities of the members of the Society during the past year compare well with the efforts of previous years.

The present year marks the completion of the fiftieth volume of the Transactions and Proceedings of the Society (including the Special Volume, XVI., which was reserved for the publication of the scientific results of the Elder Exploring Expedition). The first meeting of the Society was held in 1853, the first Annual Report being published the following year. That was as the Adelaide Philosophical Society. Vol. I., of the present series of Transactions, was published in 1877. Two years later the institution took the name of the Royal Society of South Australia. A comparison of the early volumes with those of

later date give evidence of the great extension of the Society's operations in scientific research and in placing the results of such original observations on permanent record for the information of the public generally.

PAPERS.—As usual, the geologists made important contributions, including Prof. Walter Howchin's "Geology of the Barossa Ranges" and "Geology of the Victor Harbour, Inman Valley, and Yankalilla Districts"; Prof. Mawson's "Additions to the South Australian Mineral Records," "The Wooltana Basic Igneous Belt," and "Varve Shales"; and C. T. Madigan's "Geology of the Fleurieu Peninsula, Pt. II."

Palaeontology received attention in an important work by F. Chapman and Miss I. Cookson on "The 'Sweet' Collection of Triassic Plants from South Australia."

In anthropology, Mawson and Hossfeld, Pulleine, Tindale and Mountford, and Campbell and Lewis contributed papers of interest.

In zoology, two papers, one by W. H. Baker on "The Sphaeromidae," and the other by H. Hale on "The Cymothoid Isopods," are the most important of recent years on the Crustacea of South Australia.

In entomology, papers by A. M. Lea on "Miscellaneous Coleoptera" and Jefferis Turner on "Australian Lepidoptera" are continuations of a long series of contributions by these authors. These are followed by Prof. Wood Jones, on the "Flight of Sea Birds"; F. G. Holdaway, on "*Lyponyssus*"; Prof. Harvey Johnston, on the "Propriety of Introducing Insects to Control Prickly Pear"; and "Ecological Notes on South Australian Polyplacophora," by Edwin Ashby.

In botany, Geoffrey Samuel contributed "Notes on the Distribution of *Micorrhiza*"; and J. M. Black on "Additions to the Flora of South Australia. No. 24."

EXHIBITS.—Many specimens illustrating the geology, anthropology, and zoology of the State added to the interest of the evening meetings.

DEATHS.—Two most distinguished Honorary Fellows have passed away since the last Annual Meeting—J. H. Maiden, F.R.S., elected 1892, and Charles Hedley, F.L.S., elected 1905, both men of great scientific standing, who have left an indelible mark on Australian science in their respective departments. John Conrick, the pioneer of Cooper's Creek, a Fellow since 1923, died in January.

LIBRARY.—The Library Committee has dealt with routine work and arranged additional exchanges. For the seventh time we must report the need of additional shelving if we are to avoid double-banking the volumes which are constantly being added.

COUNCIL.—Nine Council meetings were held and members attended as follows:—Prof. Osborn (President), 5; Sir Joseph Verco, 7; Prof. Howchin, 9; Sir Douglas Mawson, 5; Prof. Wood Jones, 5; Mr. L. K. Ward, 5; Mr. A. M. Lea, 7; Mr. E. Waite, 3; Dr. Cleland, 5; Dr. Fenner, 5; Mr. B. Roach, 8; Dr. R. Pulleine, 9.

During the year Prof. Wood Jones was on leave while travelling in Europe and America, and Mr. Edgar Waite was granted six months' leave for his visit to England and America. Our President (Prof. Osborn) was chosen by the Research Council to represent them at the Pan Pacific Congress at Tokyo, in October and November, 1926, and left for Japan in September, after his return from the Austr. Asso. Ad. Sc. Perth Meeting, where he and Dr. Fenner represented the Royal Society of South Australia.

The following By-law was passed by the Council on April 22, 1926, for ratification at the next ordinary meeting, under Rule 28:—

"Corresponding Members may, subject to the Rules and By-laws, be Fellows or Associates of the Society, but unless they be Fellows or Associates they shall not be liable to pay any subscription during the period of their Corresponding Membership. Such membership shall cease upon the member:

(a) Coming to reside permanently at or within ten miles of the General Post-Office, Adelaide; or

(b) Ceasing to correspond or promote the objects of the Society by furnishing papers or otherwise to the satisfaction of the Society, and for the purpose the decision of the Council by resolution shall be final.

Provided always that no Corresponding Member shall retain his membership after the lapse of a period of five years from the date of his last communication actually published in the Proceedings of the Society."

MEMBERSHIP.—The loss by death of two of our oldest and most distinguished Honorary Fellows has been equalised by the election in June, 1926, of Sir Baldwin Spencer, K.C.M.G., M.A., D.Sc., Litt.D., F.R.S., Director of the National Museum, Melbourne, for service in South Australian anthropology, and Frederick Chapman, A.L.S., F.R.M.S., Palaeontologist, Melbourne, for services in South Australian palaeontology.

The roll at present contains: 6 Honorary Members, 129 Fellows; total, 135.

F. WOOD JONES, *President.*
ROBERT PULLEINE, *Hon. Secretary.*

ROYAL SOCIETY OF SOUTH AUSTRALIA (INCORPORATED).

Receipts and Payments Account for Year ended September 30, 1926.

Receipts.

	£ s. d.	£ s. d.
To Balance, October 1, 1925		488 18 0
,, Subscriptions	138 12 0	
,, Field Naturalists' Section	53 9 6	
		192 1 6
,, Grants from Government—		
On Subscriptions	186 14 8	
For Printing Reports and Scientific Investigation	150 0 0	
		336 14 8
,, Use of Room by other Societies	2 7 6	
,, Sale of Publications	5 11 1	
,, Difference in Exchange of Cheque	0 0 11	
		7 19 6
,, Interests—		
Savings Bank Account	16 17 9	
Transferred from Endowment Fund	178 16 11	
		195 14 8
		£1,221 8 4

Payments.

		£ s. d.	£ s. d.
By Transactions—			
Printing		265 12 0	
Illustrating		115 18 4	
Publishing		11 8 6	
			392 18 10
,, Grant—Field Naturalists' Section			50 0 0
,, Library—			
Librarian		50 0 6	
Book-binding		7 10 0	
			57 10 6
,, Sundries—			
Cleaning and Lighting		7 13 6	
Printing, Postages, and Stationery		12 4 1	
Insurance		6 15 0	
Entertaining Visitors		5 11 0	
			32 3 7
,, Life Members' Accounts—			
Transferred to Endowment Fund			70 0 0
,, Balance, September 30, 1926—			
Savings Bank of South Australia		487 0 8	
Bank of Australasia	£136 5 9		
Less Outstanding Cheque	4 11 0		
		131 14 9	
			618 15 5
			£1,221 8 4

Audited and found correct,

W. CHAMPION HACKETT, } Hon.
HOWARD WHITBREAD, } Auditors.

B. S. ROACH, Hon. Treasurer.

Adelaide, October 6, 1926.

ENDOWMENT FUND.

(Capital £3,989 6s. 10d.)

	£ s. d.	£ s. d.
1925—October 1.		
To Balance, S.A. Government Stock	3,914 18 9	
Savings Bank	4 8 1	
		3,919 6 10
1926—September 30.		
„ Life Members' Account		70 0 0
„ Interest Received		178 16 11
		£4,168 3 9

	£ s. d.	£ s. d.
1926—September 30.		
By Revenue Account		178 16 11
„ £500 S.A. Govt. Con. Stock, 3 per cent. ..	292 8 9	
„ £2,000 S.A. Govt. Stock, 3¾ per cent. ..	1,997 10 0	
„ £170 S.A. Govt. Stock, 5¼ per cent.	170 0 0	
„ £1,525 S.A. Govt. Stock, 5½ per cent. ..	1,525 0 0	
	3,984 18 9	
„ Savings Bank Account	4 8 1	
		3,989 6 10
		£4,168 3 9

Audited and found correct.

W. CHAMPION HACKETT, } Hon.
HOWARD WHITBREAD, } Auditors.

B. S. ROACH, Hon. Treasurer.

Adelaide, October 6, 1926.

DONATIONS TO THE LIBRARY

FOR THE YEAR ENDED SEPTEMBER 30, 1926.

TRANSACTIONS, JOURNALS, REPORTS, ETC.,
presented by the respective governments, societies, and editors.

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LIST OF FELLOWS, MEMBERS, ETC.

AS EXISTING ON SEPTEMBER 30, 1926.

Those marked with an asterisk (*) have contributed papers published in the Society's Transactions. Those marked with a dagger (†) are Life Members.

Any change in address or any other changes should be notified to the Secretary.

Note.—The publications of the Society will not be sent to those whose subscriptions are in arrear.

Date of Election.

HONORARY FELLOWS.

1910. *BRAGG, SIR W. H., K.B.E., M.A., D.Sc., F.R.S., Director of the Royal Institution, Albemarle Street, London (Fellow 1886).
1926. CHAPMAN, F., A.L.S., National Museum, Melbourne.
1897. *DAVID, SIR T. W. EDGEWORTH, K.B.E., C.M.G., D.S.O., B.A., D.Sc., F.R.S., F.G.S., Emeritus Professor of Geology, University of Sydney, Coringah, Sherbroke Road, Hornsby, N.S.W.
1898. *MEYRICK, E. T., B.A., F.R.S., F.Z.S., Thornhanger, Marlborough, Wilts, England.
1926. SPENCER, Prof. SIR W. BALDWIN, K.C.M.G., Litt.D., M.A., D.Sc., F.R.S., Emeritus Professor of Biology in the University of Melbourne, Director of the National Museum, Melbourne.
1894. *WILSON, J. T., M.D., Ch.M., Professor of Anatomy, Cambridge University, England.

FELLOWS.

1926. ABELL, L. M., Victor Harbour.
1925. ADEY, W. J., Military Road, Grange.
1895. *†ASHBY, EDWIN, F.L.S., M.B.O.U., Blackwood.
1917. BAILEY, J. F., Director Botanic Garden, Adelaide.
1902. *BAKER, W. H., King's Park, S.A.
1926. BECK, B. B., 127 Fullarton Road, Myrtle Bank, S.A.
1902. *BLACK, J. M., 82 Brougham Place, North Adelaide.
1912. *BROUGHTON, A. C., The "Grosvenor," North Terrace, Adelaide.
1911. BROWN, EDGAR J., M.B., D.P.H., 172 North Terrace.
1883. *BROWN, H. Y. L., 286 Ward Street, North Adelaide.
1924. BROWNE, J. W., B.Ch., 169 North Terrace.
1916. *BULL, LIONEL B., D.V.Sc., Laboratory, Adelaide Hospital.
1923. BURDON, ROY S., B.Sc., University of Adelaide.
1921. BURTON, R. J., Belair.
1922. *CAMPBELL, T., D.D.Sc., Dental Dept., Adelaide Hospital, Frome Road.
1925. CARR, W. B., Partridge Street, Glenelg.
1924. CAVENAGH-MAINWARING, W. R., M.B., B.S., 207 North Terrace.
1907. *CHAPMAN, R. W., M.A., B.C.E., F.R.A.S., Professor of Engineering and Mechanics, University of Adelaide.
1904. CHRISTIE, W., c/o Griffiths Bros., Hindmarsh Square, Adelaide.
1895. *CLELAND, JOHN B., M.D., Professor of Pathology, University of Adelaide.
1907. *COOKE, W. T., D.Sc., Lecturer, University of Adelaide.
1924. CRESPIGNY, C. T. C. DE, D.S.O., M.D., 172 North Terrace.
1916. DARLING, H. G., Franklin Street, Adelaide.
1887. *DIXON, SAMUEL, Bath Street, New Glenelg.
1915. *DODD, ALAN P., Prickly Pear Laboratory, Sherwood, Brisbane.
1921. DUTTON, G. H., B.Sc., F.G.S., 21 Da Costa Avenue, South Prospect.
1911. DUTTON, H. H., B.A., Dequetteville Terrace, Kent Town.
1902. *EDQUIST, A. G., 19 Farrell Street, Glenelg.
1918. *ELSTON, A. H., F.E.S., "Hatherley," Commercial Road, Unley Park.
1925. ENGLAND, H. A., 21 Davenport Terrace, Wayville West.
1917. *FENNER, CHAS. A. E., D.Sc., 42 Alexandra Avenue, Rose Park.
1914. FERGUSON, E. W., M.B., Ch.M., Gordon Road, Roseville, Sydney.
1923. FRY, H. K., D.S.O., M.B., B.S., B.Sc., Glen Osmond Road, Parkside.
1919. GLASTONBURY, O. A., Adelaide Cement Co., Brookman Buildings, Grenfell Street.
1904. GORDON, DAVID, 72 Third Avenue, St. Peters.
1925. †GOSSE, J. H., 31 Grenfell Street, Adelaide.
1880. *GOYDER, GEORGE, A.M., B.Sc., F.C.S., 228 North Terrace.
1910. *GRANT, KERR, M.Sc., Professor of Physics, University of Adelaide.
1922. GRANT, R. L. T., M.B., B.S., M.R.C.P., Caius Chambers, 169 North Terrace, Adelaide.

Date of Election.

1904. GRIFFITH, H., Hove, Brighton.
1916. HACKETT, W. CHAMPION, 35 Dequetteville Terrace, Kent Town.
1922. *HALE, H. M., S.A. Museum, Adelaide.
1922. *HAM, WILLIAM, F.R.E.S., University of Adelaide.
1916. †HANCOCK, H. LIPSON, A.M.I.C.E., M.I.M.M., M.Am.I.M.E., Bundarra Road, Bellevue Hill, Sydney.
1924. HAWKER, CAPTAIN C. A. S., North Bungaree, via Yacka, South Australia.
1896. HAWKER, E. W., M.A., LL.B., F.C.S., East Bungaree, Clare.
1923. HILL, FLORENCE M., B.S., M.D., University of Adelaide.
1926. HOLDAWAY, F. G., M.Sc., The University, Adelaide.
1925. HOMBURG, Hon. H., Grenfell Street, Adelaide.
1924. *HOSSFELD, PAUL S., B.Sc., Carey Street, Magill.
1883. *HOWCHIN, Professor WALTER, F.G.S., "Stonycroft," Goodwood East.
1918. *ISING, ERNEST H., c/o Superintendent's Office, S.A. Railways, Adelaide.
1912. *JACK, R. L., B.E., F.G.S., Assistant Government Geologist, Adelaide.
1893. JAMES, THOMAS, M.R.C.S., 9 Watson Avenue, Rose Park.
1918. JENNISON, Rev. J. C., Mallala, S.A.
1910. *JOHNSON, E. A., M.D., M.R.C.S., Town Hall, Adelaide.
1910. *JOHNSTON, Professor T. HARVEY, M.A., D.Sc., University of Adelaide.
1920. *JONES, F. WOOD, M.B., B.S., M.R.C.S., L.R.C.P., D.Sc., F.R.S., Professor of Anatomy, University of Adelaide.
1923. JUDELL, LESTER M. W., B.Sc., Jamestown.
1926. JULIUS, EDWD., Conservator of Forests, Adelaide.
1918. KIMBER, W. J., 28 Second Avenue, Joslin.
1915. *LAURIE, D. F., Agricultural Department, Victoria Square.
1897. *LEA, A. M., F.E.S., South Australian Museum, Adelaide.
1884. LENDON, A. A., M.D., M.R.C.S., North Terrace.
1922. LENDON, GUY A., M.B., B.S., M.R.C.P., North Terrace.
1925. LEWIS, A., M.B., B.S., Adelaide Hospital.
1922. *MADIGAN, C. T., M.A., B.Sc., University of Adelaide.
1923. MAGAREY, W. A., LL.B., Pirie Street.
1923. MARSHALL, J. C., Payneham.
1914. MATHEWS, G. M., F.R.S.E., F.L.S., F.Z.S., Foulis Court, Fair Oak, Hants, England.
1905. *MAWSON, SIR DOUGLAS, D.Sc., B.E., F.R.S., Professor of Geology, University, Adelaide.
1919. MAYO, HELEN M., M.D., 47 Melbourne Street, North Adelaide.
1920. MAYO, HERBERT, LL.B., Brookman Buildings, Grenfell Street.
1926. McCOY, H. A., M.B., Ch.M., 163 North Terrace, Adelaide.
1920. McGILP, JOHN NEIL, Napier Terrace, King's Park.
1907. MELROSE, Hon. ROBERT T., M.L.C., Mount Pleasant.
1924. MESSENT, P. S., M.S., 192 North Terrace.
1925. †MITCHELL, Professor W., M.A., D.Sc., The University, Adelaide.
1897. *MORGAN, A. M., M.B., Ch.B., 46 North Terrace.
1924. MORISON, A. J., Deputy Town Clerk, Town Hall, Adelaide.
1926. MOORE, A. P. R., B.D.S., 193 North Terrace, Adelaide.
1926. MOUNTFORD, C. P., 52 West Street, Torrensville.
1921. MOULDEN, OWEN M., M.B., B.S., Unley Road, Unley.
1925. NORTH, Rev. WM. O., Methodist Manse, Netherby.
1913. *OSBORN, T. G. B., D.Sc., Professor of Botany, University of Adelaide.
1924. PEARCE, C., 33 Capper Street, Kent Town.
1924. PERKINS, A. J., Director of Agriculture, Victoria Square.
1926. PIPER, C. S., B.Sc., Waite Agric. Research Institute, Glen Osmond.
1925. PRESCOTT, Professor J. A., M.Sc., A.I.C., Waite Agric. Research Institute, Glen Osmond.
1926. PRICE, A. GRENFELL, M.A., F.R.G.S., St. Mark's College, North Adelaide.
1907. †*PULLEINE, R. H., M.B., Ch.M., North Terrace.
1916. RAY, WILLIAM, M.B., B.Sc., Liberal Club Building, North Terrace, Adelaide.
1885. *RENNIE, EDWARD H., M.A., D.Sc., F.C.S., Professor of Chemistry, University, Adelaide
1925. RICHARDSON, Professor A. E. V., M.A., D.Sc., "Urrbrae," Glen Osmond.
1911. ROACH, B. S., Education Department, Flinders Street, Adelaide.
1919. *ROBERTSON, Professor T. B., D.Sc., D.Ph., University of Adelaide.
1924. ROEGER, Miss M. T. P., c/o Central School, Goodwood.
1925. ROGERS, L. S., B.D.Sc., Verco Buildings, North Terrace.
1905. *ROGERS, R. S., M.A., M.D., 52 Hutt Street.
1922. *SAMUEL, GEOFFREY, B.Sc., University of Adelaide.
1924. SANDFORD, J. WALLACE, 75 Grenfell Street.
1924. SEGNIT, R. W., M.A., B.Sc., Architect-in-Chief's Office, King William Street.
1891. SELWAY, W. H., Treasury, Adelaide.
1926. SHEARD, HAROLD, Gawler.

Date of Election.
1920. SIMPSON, A. A., C.M.G., C.B.E., Lockwood Road, Burnside.
1924. SIMPSON, FRED. N., Dequetteville Terrace, Kent Town.
1925. SMITH, ELMER, Ph.D., Sc.D., 1281 Paterson Plank Road, Secaucus, N.J., U.S.A.
1925. †SMITH, T. E. BARR, B.A., 25 Currie Street, Adelaide.
1906. SNOW, FRANCIS H., National Mutual Buildings, King William Street.
1923. SPROD, M. W., M.B., B.S., Moseley Street, Glenelg.
1923. STRONG, Professor Sir ARCHIBALD, M.A., D.Litt., University of Adelaide
1922. SUTTON, J., Fullarton Road, Netherby.
1925. SYMONS, IVOR G., Church Street, Highgate.
1923. THOMAS, J. F., Tenterfield, N.S.W.
1923. *THOMAS, R. G., B.Sc., 5 Trinity Street, St. Peters.
1921. *TIEGS, OSCAR W., D.Sc., University of Melbourne.
1923. *TINDALE, N. B., South Australian Museum, Adelaide.
1894. *TURNER, A. JEFFERIS, M.D., F.E.S., Wickham Terrace, Brisbane, Queensland.
1925. TURNER, DUDLEY C., National Chambers, King William Street.
1878. *VERCO, SIR JOSEPH C., M.D., F.R.C.S., North Terrace.
1926. WAINWRIGHT, J. W., B.A., 32 Florence Street, Fullarton Estate.
1914. *WAITE, EDGAR R., F.L.S., C.M.Z.S., Director, South Australian Museum.
1924. WALKER, W. D., M.B., B.S., B.Sc., St. Mark's College, Pennington Terrace, N.A.
1912. *WARD, LEONARD KEITH, B.A., B.E., Government Geologist, Adelaide.
1920. WEIDENBACH, W. W., Rabaul, Papua.
1904. WHITBREAD, HOWARD, c/o A. M. Bickford & Sons, Currie Street.
1912. *WHITE, Capt. S. A., C.M.B.O.U., "Wetunga," Fulham.
1920. *WILTON, Professor J. R., D.Sc., University of Adelaide.
1923. *WOOD, J. G., B.Sc., Caius College, Cambridge, England.

APPENDIX.

FIELD NATURALISTS' SECTION

OF THE

Royal Society of South Australia (Incorporated).

FORTY-THIRD ANNUAL REPORT OF THE COMMITTEE

FOR THE YEAR ENDED AUGUST 31, 1926.

The Committee has pleasure in presenting the Annual Report and to congratulate members on completing another successful year. The activities of the Section have been well maintained and much useful work has been accomplished.

EXCURSIONS.—The excursions, numbering 23 for the year, have been made to places of interest, including some within the city and others 40 miles away. The charabanc trips have been well attended, and the finances show a balance of £6 19s. 3d. in hand. The subjects studied have been numerous, and included botany, birds, orchids, marine life (dredging), shells and shore life, native fauna, geology, fossils, and freshwater aquatic life. The leaders are to be thanked for devoting their time in this way, and for the mass of information given in respect to their various branches of Natural History.

LECTURES AND EXHIBITS.—The lectures have been again of a very high type, and we are deeply indebted to those members and others who have delivered them. The preparation necessary is considerable, and some expense, often not a little, is incurred by our generous lecturers to give the members a wide range of information on their respective subjects. The Section is particularly grateful to the lecturers, as it has not been able to assist in the preparation of the lantern slides. On September 15, Capt. S. A. White gave a lecture on "Birds of Economic Value in the State," illustrated by bird skins; on October 20, Prof. Sir Douglas Mawson, President of the Royal Society, 1924-25, lectured on "Exploring in Antarctica," illustrated by lantern slides; on November 15, Mr. Walter Gill, late Conservator of Forests, gave a lecture entitled "Forest Scenes," illustrated by lantern slides; on March 16, the following made exhibits with suitable remarks thereon:—Miss E. D. Macklin, Dr. Watson, Prof. J. B. Cleland, Messrs. W. J. Kimber, W. A. Harding, J. F. Bailey, and E. H. Ising; on April 20, Prof. T. G. B. Osborn, President of the Royal Society, 1925-26, gave an illustrated lecture on "Plant Life in Arid Australia"; on May 18, the following made microscopic exhibits and appropriate remarks thereon:—Prof. T. H. Johnston, Dr. R. H. Pulleine, Messrs. J. F. Bailey, W. H. Webb, W. A. Harding, A. J. Morison, and E. C. Cole; on June 15, Mr. J. F. Bailey lectured with lantern slides on "Australian Vegetation"; and on July 20, Mr. F. G. Holdaway letctured on "An Australian Plant Bug: its Life and Economic Importance," illustrated by lantern slides. The lecture-room was engaged on four occasions, and the public were invited to the lectures.

Our Journal.—Our quarterly journal, "The South Australian Naturalist," has been published regularly, and the standard has been raised by articles by Prof. J. B. Cleland on "The Plants of Encounter Bay District"; by Tellurian on "Plants of Arid Lands"; by Mr. A. M. Lea on "The Black Cicada, or Red-eye"; Messrs. W. Ham, T. W. Nettelbeck, F. Trigg, and E. H. Ising on an "Easter Camp at Finniss," with description of its Natural History; by Mr. H. M. Hale on "Habits of the Smooth Pebble-crab"; by reports of the proceedings of the Shell Collectors' Club; and by Messrs. W. Ham and E. H. Ising on "South Australian Trees." Various illustrations also added value to the publication. The cost of printing was £69 7s., compared with £34 12s. 2d. for 1924-25.

Exchanges.—The exchange list consists of publications of similar bodies and Royal Societies in the other States, and others from various parts of the world. American Scientific Societies are eager to receive our journal, and we exchange with several large institutions, such as the Smithsonian of Washington, and Natural Academy of Sciences, Philadelphia.

Flower Show.—The 1925 effort was a pronounced success, the Public Schools again coming to our aid. Through the kindness of the Minister and Department of Education, we were permitted to approach a selected number of schools who never fail to supply an abundance of flowers. Interstate clubs also help in a wonderful way with the best of their flowers, and with the continued efforts of members and friends we are able to make a creditable display. The net proceeds realised £43 6s. 4d., as compared with £35 18s. last year.

Herbarium.—The Herbarium Committee has met on many occasions in Prof. Cleland's Rooms, Darling Building, University, where the plants are stored. Quite a large number of plants were pressed from the collections of various schools sent for the Wild Flower Show, and these, with some of the Tepper Herbarium, have been sorted into their separate families. Collections have been made at various times in the reserves at Morialta, Waterfall Gully, and National Park, Belair, and it is hoped to publish lists and articles on these reserves early next year.

Membership.—Fluctuations still continue to take place in the membership list. There were 24 new members admitted during the year. At the beginning of the year the total was 184 and the full total now is 186, out of which 149 are financial.

Australasian Association for the Advancement of Science Perth Meeting, August, 1926.—The Section was invited to send delegates to Perth for the meeting, and the following were appointed:—Mr. J. F. Bailey (Chairman of the Section), Prof. T. Harvey Johnston (Vice-Chairman), and Miss E. D. Macklin, B.Sc.

Obituary.—It is our sad duty to record the loss of Mrs. S. A. White, who had been a member for many years and was a valuable helper, specially on the occasions of the Wild Flower Show. The sympathy of the members has been extended to Capt. White in his sad bereavement.

Library.—Beyond the fact that interest is being maintained in the Library, there is nothing to report until we are in the position of possessing a cupboard to house our books adequately.

Shell Collectors' Club.

This Club met for the first time in June, 1925, the Chairman being Mr. W. J. Kimber, and Hon. Sec., Mr. F. Trigg. Meetings have been held continuously

since that date, on the first and third Mondays in each month. Average attendance 15, out of a membership of 25.

The objective of the Club is for members to obtain an elementary knowledge of South Australian Mollusca. Tryon's "Manual of Conchology" has been adopted as the principal text book. Members also, in addition to other works of reference, have provided themselves with May's "Illustrated List of Tasmanian Shells." These, in conjunction with Sir Jos. Verco's MS. List of S.A. Shells, which he has kindly made available to the Club, have afforded members a good foundation to work on. The work done so far has been a preliminary review of the S.A. bivalves, and about one-half of the univalves. It is intended, later, to give each shell, as far as possible, a more complete study.

Members have been enthusiastic and painstaking in their collecting, study, and attendance. Many beach excursions have been made by groups of members since the inauguration of the Club, which have been helpful in providing specimens for study from a fairly wide range of beaches.

(Signed) J. F. Bailey, *Chairman.*
Ernest H. Ising, *Hon. Secretary.*

FIELD NATURALISTS' SECTION OF THE ROYAL SOCIETY OF S.A.

Statement of Receipts and Expenditure for Year ended August 31, 1926.

GENERAL ACCOUNT.

Receipts.

	£ s. d.	£ s. d.
1926—August 31.		
To Balance Carried Forward, 31/8/25		36 14 8
„ Subscriptions		53 9 6
„ Other Receipts—		
Grant from Royal Society	50 0 0	
Flower Show	43 6 4	
Bank Interest	2 2 0	
Badges, etc.	1 8 11	
		96 17 3
		£187 1 5
September 1, 1926—To Balance B/d		30 0 7

Expenditure.

	£ s. d.	£ s. d.
1926—August 31.		
By Printing	69 7 0	
„ Postage	7 10 0	
„ Advertising	3 3 4	
„ Hire of Hall	5 4 1	
„ Travelling Expenses	0 18 3	
„ Stationery	1 0 4	
„ Honorarium	10 10 0	
„ Repayment to Royal Society	53 9 6	
„ Sundries, Books, Goods, etc.	5 18 4	
		157 0 10
„ Bank Balance, 31/8/26		30 0 7
		£187 1 5

Audited and found correct,

(Signed) WALTER D. REED, F.C.P.A., } Hon.
ALEX. J. MORISON, } Auditors.

August 14, 1926.

F. TRIGG, Hon. Treasurer.

August 11, 1926.

GENERAL INDEX.

[Generic and specific names in italics indicate that the forms described are new to science.]

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